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BIONOMICS OF *ECTOPSOCUS PUMILIS* (BANKS) (CORRODENTIA, CÆCILIIDÆ)[1]

By Kathryn M. Sommerman[2]

University of Illinois, Urbana, Ill.

Two species of *Ectopsocus* have been recorded from the United States: *E. pumilis* (Banks) and *E. californicus* (Banks). The former has been found commonly on corn (maize). Although *E. californicus* has been taken from the palm *Areca lutescens* in the greenhouses of the University of Illinois, and has been reared for several generations in the laboratory on corn sheaths, it has not been found in the cornfields.

E. pumilis has been recorded previously from New York, Virginia, North Carolina, Georgia, Florida, Louisiana, Tennessee, Kentucky, and Missouri, where it occurs almost throughout the year, but most commonly in September and October. During this work it has been taken in Missouri, Tennessee, Illinois, North Carolina, Florida and Connecticut. It is interesting to note that these records are limited to the eastern states.

Complete descriptions of the adults may be found in the works of Banks (2), Chapman (3) and further notes are given by Ball (1). The males (Figs. 12, 15) can be readily distinguished from the females (Fig. 7) by the elaborate, darkly-pigmented genitalia that are apparent on the dorsal side of the abdomen.

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[1] Contribution No. 230 from the Entomological Laboratories of the University of Illinois. This paper was included as a part of a thesis submitted in partial fulfillment of the requirements for the Degree of Master of Science in Entomology in the Graduate School of the University of Illinois, 1941.

[2] I wish to express my appreciation of the suggestions made by Professors C. L. Metcalf and W. V. Balduf during this work. Thanks are also due Dr. A. B. Gurney of the U. S. Bureau of Entomology and Plant Quarantine for determination of the species concerned.

Only two variations in wing venation were found on the many specimens examined. Figure 10 shows a malformed short wing, that appeared on two individuals, the opposite wing being normal. Figure 11 illustrates the one case where peculiar venation was found in an otherwise normal wing. The extremity of R_{4+5} is bent and M_1 does not reach the margin of the wing. Figure 14 is a normal wing. A greater degree of stability in wing venation is apparent in this genus because anomalies have rarely appeared among the individuals of *E. californicus* that have been raised on corn sheaths in the laboratory. Perhaps this lack of variability accounts for the fact that the genus is limited to two species in the United States.

E. pumilis first attracted my attention in October, 1938 when it was found in great numbers infesting the ears of corn in fields at Lawrenceville, Ill. During this work it has been taken from dry alfalfa stubble, dry grass, dead *Viburnum*, bamboo furniture, dried leaves of oak, maple, elm and palm. Habitats previously reported were dead oak leaves, straw and debris indoors, and windows of a cattle barn.

Of the thirty-five species in the family Cæciliidæ recorded from the United States this is one of twenty-two for which both males and females are known. The two species of *Ectopsocus* have both sexes known, but it is interesting to note that both males and females of the related species *E. californicus* have been taken only in California, while the females alone have been collected from Connecticut, New York, Virginia, Kentucky, North Carolina, Tennessee, Georgia and Florida. From work done by McClure (4) on the life history of *E. californicus* on palms in the University of Illinois greenhouses, and from my observations of this species in corn sheath cultures it is evident that *E. californicus* reproduces parthenogenetically and males do not occur. This information, along with collection records, suggests that *E. californicus* might be parthenogenetic in the East. It is interesting to note that the known distribution of the eastern parthenogentic (?) strain of *E. californicus* coincides almost state for state with that of *E. pumilis*. The sex ratio of *E. pumilis* was 0.5 and reproduction by parthenogenesis was not observed at any time.

Mating. — Copulation was observed several times, but the procedure varied to some extent each time. Sometimes the male just approached the female from the side, and backed into the mating position. On other occasions they approached each other and bumped head-on several times and furiously rubbed their heads together; then the male tried to approach the female from the side. The female raised the anterior part of her body and the male backed under with his wings erect. The female was directly above the male, but when the genitalia were united she side-stepped and the male's wings dropped back and rested across hers. They remained perfectly motionless, except for an occasional twitch of the palpi or antennæ, for twenty-two minutes. Usually the male started to walk first and when he stopped the female started. This brought them almost to a 180° angle, facing in opposite directions. Each tried to go its way, with the result that the male usually dragged the female a short distance. Then they separated. A few minutes later the male approached as before, then stood still and appeared to rapidly raise his abdomen and head and rock forward and backward. It was not possible to determine if the tip of the abdomen or labium touched the substratum during these rapid motions. The male again approached the female and, failing to regain the mating position, went through these movements again. The genitalia of the male remained exposed for some time after mating (Fig. 13).

Copulation apparently did not occur within twenty-four hours after both sexes had moulted to the adult. Eggs deposited by females exposed to males for that period only did not hatch. In several instances adult males were observed trying to copulate with nymphs in the sixth instar.

Oviposition. — Eggs were found in the field in the fall and late spring on the inside of the corn sheaths (Fig. 8). They were most commonly found on the sheaths about four or five feet up on the stalk. The lower sheaths apparently fitted too tightly around the stalk, making it almost impossible for the cæciliids to crawl under the sheath. Near the top of the stalk the inner surface of the sheaths is exposed, offering little protection from the weather; so eggs were seldom found there. In late fall the eggs were sometimes found on exposed ears especially around kernels injured by the corn earworm. In late summer eggs were found on the drying leaves (Fig. 9) in the tunnel formed by the midrib and especially around caked pollen.

Eggs were laid in groups of one to sixteen, most commonly four to eight with an average of about six. The females seemed to prefer the smooth surface of the glass, because the eggs were deposited on the glass and cork more often than on the corn in the rearing cages, which are described by the writer, Sommerman (5).

When males were continually present, egg-laying started from two to four days after moulting to the adult, and continued two to four weeks, but eggs were not always deposited each day. The number of eggs in the first group deposited ranged from three to nine, and as the end of the oviposition period approached the number did not always dwindle. The number of egg masses per individual ranged from one to fourteen. There seemed to be a tendency to add eggs to previously deposited masses, resulting in fewer masses with a larger number of eggs per mass. Some females also scattered individual eggs. Material collected in the field indicated that the eggs were usually deposited in masses. There did not appear to be any particular production peak, the number varying from day to day without any gradual increase or decline. The maximum number of eggs deposited by any female was 92. Death usually occurred five or six days after oviposition ceased.

Non-fertilized females usually deposited their first eggs from three to eight days after the last moult. Fifty was the maximum number laid by any virgin. None of these ever hatched. After oviposition ceased these females continued to live up to twenty-four days, making the adult stage for virgins usually about forty-three days, whereas the adult stage for fertilized females lasted about twenty-one days. Adult males usually lived about thirty-nine days but one male was collected in the field April 9, 1940 and died June 15, having lived sixty-seven days in a rearing tube. It is probable that this male had also passed the winter as an adult.

The process of oviposition is similar to that described for *Cæcilius manteri* Sommerman (6). Eggs are deposited in masses and silk threads are spread over them but not in a dense sheet as in *C. manteri* or *E. californicus*. The silk threads are numerous. They criss-cross at various heights forming a loose network. The females wander about after depositing each egg. Within thirty minutes one female had deposited a mass of six eggs, and had started to cover them with silk. She rapidly turned and turned, fastening the threads here and there, and within four minutes had completely covered the mass and wandered away.

Egg Stage. — Eggs (Fig. 1) are oval and flattened only on the surface contacting another object. The shells are smooth and shiny. Measurements of fifteen eggs chosen at random averaged 0.388 mm. in length and 0.208 mm. in width. The eggs were white when first laid, but turned a creamy yellow as development progressed. This change in color made the eggs still more difficult to find because they blended with the dried sheaths. They are easily overlooked because the silk is not dense enough to shine as it does in *E. californicus* or *C. manteri*.

Embryonic development was easy to observe in this species. The chorion and vitelline membrane remained practically transparent, so the eyes of the embryo could be seen clearly on the fifth day of development, which was the day before hatching. Fifteen egg masses kept under laboratory conditions hatched on the sixth day. As the time for hatching approaches, the eggs become a little darker and the chorion wrinkles to the form of the body and appendages (Fig. 2). The embryo is ventral side up and the head, eyes, antennæ, legs and tip of the abdomen are easily visible. The arms of the egg burster (Fig. 4) stretch across the front of the head with the center puncturing shaft projecting posteriorly toward the clypeus. The heads of several individuals were observed pulsating before the chorions were broken, and in one case as much as eight hours before. This activity, spasmodic at first, occurs at more regular intervals until at the time the chorion splits the top of the head is pulsating regularly. Air bubbles appeared to be passing into the embryo through the mouth before the split in the chorion could be seen on the anterior end of the egg.

Hatching. — The pronymph, within its membrane, slipped from the chorion and vitelline membrane with no apparent effort at first, then as it rose it swayed back and forth. Fifteen minutes after the chorion was noticeably broken the egg burster punctured the pronymphal membrane. This differs from the report of Wachter (8) who states that the egg burster ruptures the chorion and that the vitelline membrane is broken by internal pressure. This puncture lengthened to a slit that continued to progress toward the eyes. It required another fifteen minutes before the head was completely free of the pronymphal membrane. At this time bubbles of air were passing into the head, which was becoming transparent. Thirty-five minutes from the time hatching started the head, thorax and most of the abdomen were out of the shell, and two minutes later the antennæ and legs were free. Forty-two minutes from the start the nymph dropped down and stood beside the chorion. At this time the pulsations on the vertex could still occasionally be seen, and the bubble of air in the head extended anteriorly as far as the eyes. The segments of the abdomen were telescoping into their normal position. One hour after hatching started, the bubble in the head had almost completely disappeared. Several other individuals completed hatching in twenty-five and thirty minutes. The pronymphal exuviæ bearing the egg burster always remained partly extruded from the chorion.

Postembryonic Development. — The nymphs (Figs. 3, 5, 6) are buff with slightly darker appendages during the early instars and gradually become light brown. There are bristle-like setæ on the head and thorax. The dull color of the abdomen gives this species a characteristic velvety appearance. The antennæ are eight-segmented in the first instar (Fig. 3) and thirteen-segmented thereafter. The wing pads appear in the third instar (Fig. 5) and the forewings approximately double their length with each successive moult. The sexes of the sixth instar nymphs can easily be distinguished because the asymmetrical genitalia of the male show through on the dorsal surface of the abdomen (Fig. 6). The duration of the six instar periods was as follows: first, 2.3 days; second, 2.4 days; third, 2.4 days; fourth, 2.7 days; fifth, 2.8 days and the sixth, 4.4 days. Apparently the last instar period is longer than any of the others, which is also true in *C. manteri* (6). The measurements in the following table were taken from ten preserved specimens in each instar:

Instar	First mm.	Second mm.	Third mm.	Fourth mm.	Fifth mm.	Sixth mm.	Adult mm.
Head width	0.190	0.250	0.293	0.375	0.450	0.507	0.552
Antennal length	0.338	0.440	0.512	0.627	0.763	0.900	1.097
Forewing length	....	....	0.094	0.175	0.333	0.616	1.607

The complete nymphal period averaged 17.3 days with a minimum of twelve and a maximum of twenty-seven. The nymphal period could probably be lengthened still more if feeding conditions were poor, because this species, like *Lachesilla nubilis* (Aaron), eats the epidermis and mesophyll of the sheaths when fungus is scarce. The total length of all the life stages was usually about 53 days.

Moulting.—Often the nymphs ate their exuviæ, thus making it difficult to determine moults in cases where measuring was impossible. The majority of the exuviæ were in a vertical position with the head down, but some were horizontal. Moulting seemed to be the same as that described for *C. manteri* (6). The epidermis split along the top of the thorax and head. The nymph arched up, with the antennæ held down along the sides of the body. The head was finally freed and gradually the nymph rose until it was actually resting on the end of its abdomen, although the tarsi of the exuviæ were in contact with the substratum. When almost vertical the antennæ were released, then the legs. All this time air bubbles were being swallowed and the abdomen stretched out. After moving the legs it bent over, freeing the tip of the abdomen, and stood beside the exuviæ. After a short time the abdomen contracted to its normal length. One adult was observed from the time it first freed its legs from the exuviæ until its wings were completely unfolded. Five minutes after freeing the legs it walked from the exuviæ. The wings were beginning to unfold; so it turned around to a vertical position with the head up. In twelve minutes the wings were completely straightened and were the same light color throughout. After the third instar one can determine when moulting will occur because the thick wing pads stick out from the body as in Figure 6.

Habits.—Under laboratory conditions the nymphs and adults eat fungi, epidermis and mesophyll of the corn sheaths, pollen, embryo and starch of broken corn kernels, exuviæ, and dead of their own kind. This species seemed to get along very well on the embryo and starch of the corn kernels. In some cases when they finished there was nothing left but the hard yellow seed coat of the kernel. Silk is deposited by the nymphs and adults. Although the quantity produced by *E. pumilis* is considered rather conspicuous it is a small amount in comparison to that deposited by *E. californicus*. *E. pumilis*, like *C. manteri*, gave a sudden start when the cotton plugs in the rearing cages were moistened, and they usually pushed their mandibles into the cotton and took water from the plugs. There seemed to be a tendency for both the nymphs and adults to walk upward, if confronted with a vertical surface. This negative geotropism made this species easy to handle. If a glass tube were placed over an escaped nymph or adult it immediately walked up the side of the glass to the cotton plug. Other species sometimes had to be coaxed for a long time before they would walk upon a piece of corn sheath. This habit made it easy to transfer cultures from an old cylinder to a freshly prepared one. This species was successfully reared both in colony and individual cultures as described by Sommerman (5).

The adults exhibited somewhat regular periods of extreme activity. This was especially noticeable in cultures decidedly overcrowded (i.e., in comparison to any conditions normally found in the field). Late at night they became active but the cause is not known. They may have been stimulated by hunger, temperature, light from the desk lamp, or perhaps it was just a daily rhythm.

Overwintering. — This species was numerous on corn plants only in the fall. The heaviest infestation encountered occurred at Lawrenceville, Ill., in October 1938. In December 1939 it was numerous in a cornfield at Urbana, and was the common species found on corn at Mt. Carmel, Conn., during the same month. Eggs were not easy to find. Those taken in the field from December to April did not hatch when brought into the laboratory or when left out of doors. Usually eggs found during the winter were straw-colored and withered. Adults taken from the field December 30, 1939 at Mt. Carmel, Conn., deposited fertile eggs within two days after being brought in from out of doors. Living nymphs or adults were not taken in the field between January first and April first. An active male that had probably overwintered was found in the sheath on an uprooted corn stalk April 9, 1940.

On December 12, 1939 some nymphs and adults of *E. pumilis* were put in a tube and left out of doors. February 6 they were transferred out of doors to a clean tube. On April 1 an adult male, female and three nymphs were still alive. The cotton plug in the tube was moistened and they all drank readily. By April 9 these individuals had become active and their bodies were plump. By April 16 the overwintering female had deposited a mass of ten eggs. These eggs were taken into the laboratory for rearing, to see if the change from variable out-of-doors temperatures to the abnormal indoor temperature would interfere with hatching. Seven of the ten hatched and all the nymphs matured. On April 21 one of the overwintering nymphs moulted to an adult and the overwintering female had also laid a group of eleven more eggs. These eggs were left out of doors and they hatched May 4. By May 12 these nymphs had reached the third instar. By May 25 they were in the sixth instar. The overwintering nymphs matured and deposited eggs that hatched, their nymphs likewise maturing. The overwintering nymphs and adults, and the unsuccessful attempts to hatch overwintering eggs suggest that a few nymphs or adults manage to survive the winter and continue their normal activities in the spring. They were not found during late June and July, but on August 1 adults and eggs were taken on the dried leaves of new corn.

Parasitism. — Groups of *E. pumilis* eggs were exposed to adults of *Alaptus cæcilii* Girault (Hym., Mymaridæ) that had emerged from the eggs of *Cæcilius aurantiacus* Hagen. Various groups of eggs were exposed on April 1, 5 and 11, but the eggs did not hatch and parasites did not emerge. The parasites were not definitely observed ovipositing in these eggs but they did walk over them. Other groups of eggs laid by the same female, not exposed to the parasites, hatched and matured normally. This scanty information suggests that *A. cæcilii* oviposited in the eggs, that the embryo was destroyed and that conditions were not favorable for the complete development of the parasites; so neither emerged. It is interesting to note that Spruyt (7) records *Alaptus cæcilii* from the eggs of *Ectopsocus californicus* (Banks), the other species of this genus in the United States, and which is also parasitized by *Alaptus psocidivorus* Gahan.

Summary. — Adults of *Ectopsocus pumilis* have been taken in many of the eastern states as far west as Missouri. Both sexes are known and the sex ratio is 0.5. The eggs are smooth-shelled and are laid in masses covered with a loose network of threads. The nymphs and adults feed on fungus, pollen, starch and embryos of the corn kernels and on the corn sheaths. The egg stage requires six days. The egg burster, apparently on the inside of the pronymphal membrane punctures the latter, while the chorion and vitelline membrane are probably broken by internal pressure. The nymphs swallow air bubbles at hatching and at moulting. The pronymphal membrane, with the egg burster attached, is always found protruding from the chorion after hatching. The antennæ are eight-segmented in the first instar and thirteen-segmented thereafter. Wing pads appear on the third instar and about double their length with each moult. During moulting the nymphs are in a vertical position with the head down. The nymphal stage requires about seventeen days and the adult stage lasts about thirty days. The usual life span including the period within the egg is fifty-three days. Silk is deposited by all nymphs and adults. Winter is probably spent in the adult or nymphal stage.

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EXPLANATION OF PLATES

Plate V.

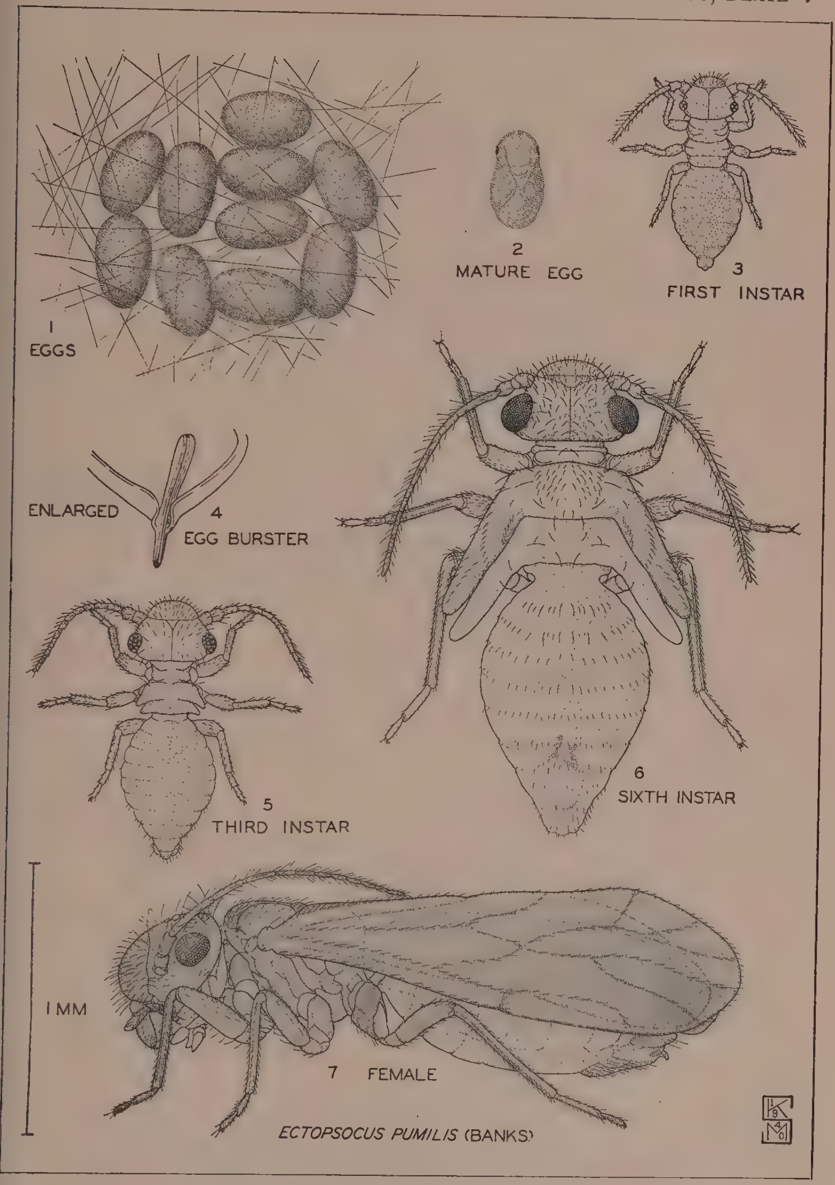
Figure 1. Egg mass covered with silk threads.
Figure 2. Mature egg.
Figure 3. First instar (dorsal view).
Figure 4. Egg burster (enlarged).
Figure 5. Third instar (dorsal view).
Figure 6. Sixth instar (dorsal view).
Figure 7. Female (lateral view).

Plate VI.

(Scale of enlargement applies only to Figures 12 and 15.)

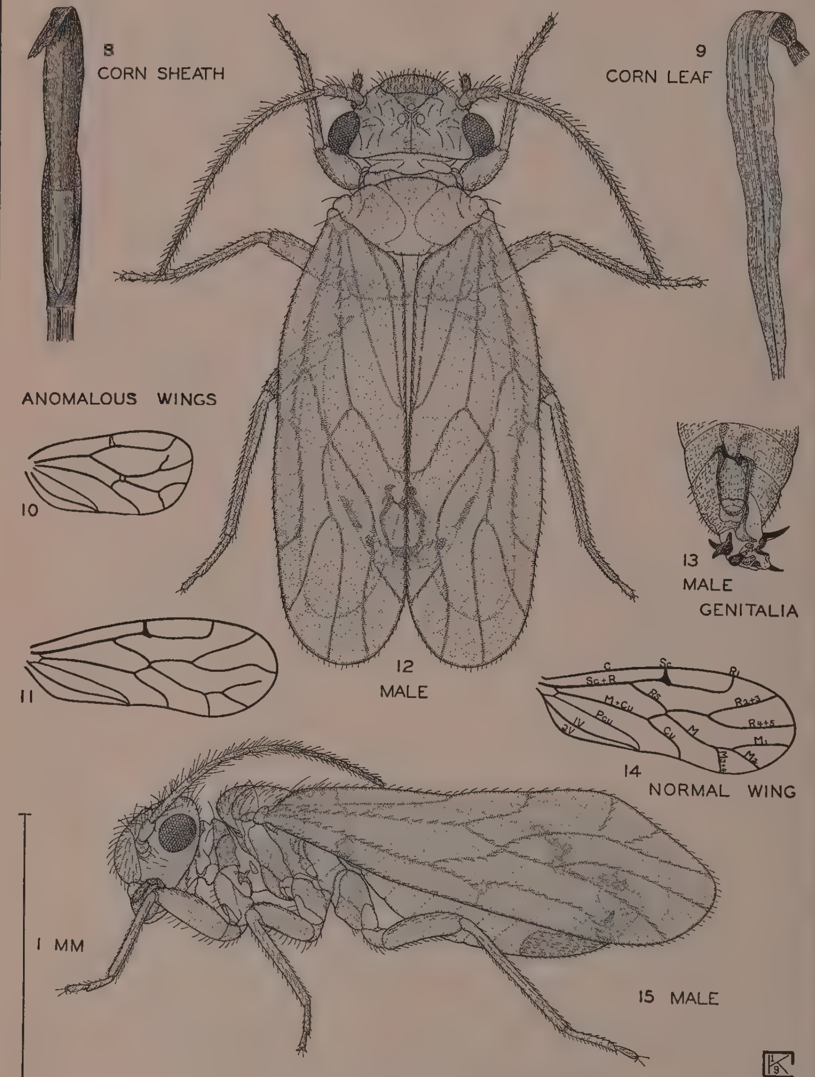
Figure 8. Corn sheath.
Figure 9. Corn leaf.
Figure 10. Malformed short wing.
Figure 11. Anomalous wing.
Figure 12. Male (dorsal view).
Figure 13. Protruding male genitalia (dorsal view).
Figure 14. Normal wing.
Figure 15. Male (lateral view).

PSYCHE, 1943 VOL. 50, PLATE V



ECTOPSOCUS PUMILIS (BANKS)

Sommerman — *Ectopsocus pumilis*



ECTOPSOCUS PUMILIS (BANKS)

Sommerman — *Ectopsocus pumilis*

SOME NEW NORTH AMERICAN SPECIES OF *EPICAUTA* (COLEOP., MELOIDÆ)[1]

By Floyd G. Werner

Biological Laboratories, Harvard University

The completion of my revision of the genus Epicauta having been delayed by my entrance into the U.S. Army, I have decided to publish separately the new species in it so that they will be available to workers in this group. They will be described more fully in my revision.

Epicauta maculata (Say)

Black, clothed with olive-cinereous to cinereous pubescence, with numerous denuded spots. Maxillary palpi of male enlarged, flattened, labial palpi small. Male anterior tarsi not modified. East of the Rocky Mountains, from North Dakota to Wickenburg, Arizona and eastward to western Iowa and Missouri.

Epicauta nogales sp. n.

Male labial palpi not nearly as greatly expanded as in *maculata*. Male anterior tarsi not modified. Elytra shorter and broader, leaving the tip of the abdomen broadly exposed. Denuded spots small.

Holotype: ♂, Nogales, Arizona, Aug. 10–13 Wickham (MCZ No. 26085).

Allotype: ♀, eutopotypical (MCZ).

Paratypes: 4 eutopotypical (MCZ), 1 eutopotypical (USNM), 1 topotypical — Sept. 9, 1906 — Nunenmacher (USNM), 2 Tucson, Arizona (USNM).

Epicauta normalis sp. n.

Replaces *maculata* from the Rockies to the Pacific, except in Arizona. Maxillary palpi as small in the male as in the female.

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[1] Published with the aid of a grant from the Museum of Comparative Zoölogy at Harvard College.

First segment of male anterior tarsi narrow, slightly outcurved, with the pad absent from at least the basal three-fourths.

Holotype: ♂, Bridgeport, California, July 12–15 Wickham (MCZ No. 26086).

Allotype: ♀, eutopotypical (MCZ).

Paratypes: CALIFORNIA: 6 eutopotypical (MCZ), 3 Cal. (MCZ), 6 Shasta Valley (AMNH), 2 Eagleville (AMNH). OREGON: 1 Echo (MCZ), 1 Burns (MCZ), 1 Or. (MCZ). WASHINGTON: 2 Yakima Valley (MCZ), NEVADA: 2 Paymaster Cañon — Lone Mt. (ANSP), 5 Reno (Werner), 3 Nev. (MCZ). IDAHO: 1 Ruhl (MCZ). WYOMING: 2 Green River City (MCZ), 1 Laramie (Ohio), 3 Wy (MCZ). MONTANA: 2 Helena (MCZ). UTAH: 1 Fillmore (BYU), 1 American Fork (BYU), 1 Sheep Creek-Duchesne Co. (BYU), 1 Jordan River (BYU), 1 Provo (BYU), 1 Indianola (BYU), 1 Ogden (AMNH), 1 Ut. (MCZ). COLORADO: 8 Manitou (MCZ), 2 La Veta (MCZ), 2 Colo. Spgs. (1 MCZ, 1 Ohio), 5 Windsor (3 Colo., 2 Werner), 2 Ft. Collins (Colo.), 2 Colo. (1 MCZ, 1 Ohio). ARIZONA: 4 Chiricahua Mts. (Ohio), 1 Huachuca Mts. (Ohio).

Epicauta phoenix sp. n.

Elytra more convex than in the others in this group. Antennæ shorter and more slender. Spots on the elytra moderately large, elsewhere small and indistinct. Male with the palpi small, the anterior tarsi normal.

Holotype: ♂, Phoenix, Arizona, Liebeck Coll. (MCZ No. 26070).

Allotype: ♀, eutopotypical (MCZ).

Paratypes: Phoenix, Arizona: 11 (MCZ), 6 July 16–18 Wickham (5 MCZ, 1 USNM), 2 Wenzel Coll. (Ohio). 3 Ariz. (2MCZ, 1 AMNH).

Epicauta andersoni sp. n.

Close to *pardalis* Lec. but has both pairs of palpi enlarged and flattened in the male and with the antennæ more slender.

Holotype: ♂, Gallo Springs, New Mexico VI–21 Green (USNM).

Allotype: ♀, eutopotypical (USNM).

Paratypes: NEW MEXICO: 4 eutopotypical (USNM). ARIZONA: 1 Flagstaff VI–20–35 Wildermuth, on potatoes

(USNM), 1 Flagstaff, VIII–2–37 Maehler (Colo.). TEXAS: 1 Childress VI–8–06 Mitchell (USNM). KANSAS: 1 Ks. (MCZ NO. 26084).

Epicauta uniforma sp. n.

This is one of the species from the Southwest misidentified as "*cinerea*." Uniformly clothed with dull ferrugineous to golden pubescence, and without markings at the base of the elytra. First segment of male antennæ slender, reaching to the hind margin of the eye, not covered with golden pubescence. Head subquadrate. Antennal calluses not denuded. Eyes moderately narrow.

Holotype: ♀, Ramah, Arizona — Aug. — Vestal (MCZ No. 26581).

Paratypes: COLORADO: 1 LaJunta (AMNH), 1 Hoehne (Parker). TEXAS: 7 Davis Mts. (6 Ohio, 1 Parker), 1 Odell (ANSP), 1 Chisos Mts. (Parker), 1 Texas (Parker). ARIZONA: 1 Baboquivari Mts. (Ohio), 1 Nogales (Ohio), 1 Patagonia Mts. (Ohio), 4 Tombstone (2 ANSP, 2 Frost), 2 Douglas (Parker), 2 Tucson (Parker), 1 Picacho (Parker), 1 Tucson-Liebeck Coll. (MCZ).

Epicauta alpina sp. n.

Similar to *uniforma* but always clothed with golden pubescence and narrower. First segment of antennæ with golden pubescence and in the male extending one-fourth its length beyond the eye, slightly excavated externally near the tip. Head rather narrowly triangular, especially in the male.

Holotype: ♂, Alpine, Texas Jul. 20–22, 4400–6000 ft., Wickham (MCZ No. 26061).

Allotype: ♀, eutopotypical (MCZ).

Paratypes: TEXAS: 2 eutopotypical (1 MCZ, 1 USNM), 2 Alpine (USNM), 3 Texas (Parker). NEW MEXICO: 1 Deming (Parker).

Epicauta brunnea sp. n.

Another Western species commonly misidentified as "*cinerea*." Large, black, the elytra brown; entirely clothed with appressed ferrugineous pubescence. Elytra darker across the base. First segment of the anterior tarsi of the male with the pad broadened, about twice as broad as on the second segment.

Holotype: ♂, Alpine, Texas, 6000 ft. 8–15–26 (MCZ No. 26064).

Allotype: ♀, topotypical 8–20–26 (MCZ).

Paratypes: TEXAS: 1 topotypical (MCZ), 2 Brewster Co. (MCZ), 1 Fort Davis (Frost), 1 Sabinal (USNM). ARIZONA: 2 Sta. Cruz Village-Cobabi Mts. (1 ANSP, 1 AMNH), 2 Superior (1 ANSP, 1 AMNH), 1 Douglass (USNM), 4 Capitan Mt. (3 Parker, 1 Werner), 1 Globe (Parker), 2 San Carlos (1 Parker, 1 Werner), 1 Canon Lake (Parker), 1 Gila Valley (Parker), 1 Whiteriver (AMNH). COLORADO: 1 Denver (Ohio).

Epicauta floridensis sp. n.

Similar to the cinereous form of both species known as *cinerea* in the East. The antennæ are slightly more slender than in the species which feeds on *Clematis* and have the first segment more slender. Posterior tibial spurs slender. Smaller and more slender than either species.

Holotype: ♂, Sebring, Florida VI–1–10–42 Parsons (MCZ No. 26067).

Allotype: ♀, eutopotypical (MCZ).

Paratypes: FLORIDA: 15 eutopotypical (MCZ), 1 Croom (MCZ), 2 Cleveland (MCZ), 4 Capron (USNM), 1 Biscayne (USNM), 2 Tampa (USNM), 3 Cutler (USNM), 2 Jacksonville (USNM), 1 St. Nicholas (USNM), 2 Lake Istopoga (MCZ), 8 Fla. (MCZ). NEW JERSEY: 4 DaCosta (MCZ). MISSISSIPPI: 1 Lucedale (MCZ).

Epicauta punctipennis sp. n.

Black or dark brown, elytra ferrugineous. Rather densely clothed with tannish-cinereous pubescence. Elytra with small, sparsely scattered, denuded spots. There are no spots on the rest of the body. Male anterior tibiæ with two spurs.

Holotype: ♀, Columbus, Texas, May 24, 1879 LeConte Coll. (MCZ No. 26159).

Allotype: ♂, "Tex.," Liebeck Coll. (MCZ).

Epicauta ensiformis sp. n.

Black, sparsely clothed with erect black pubescence. Resembles *oblita* in general form but has the antennæ strongly ensiform, with the third segment the broadest and flattened.

Anterior tibiæ of male with two spurs and male anterior tarsi not modified.

Holotype: ♂, "Cal." with an ink spot on the lower part of the "a," Liebeck Coll. (MCZ No. 26079).

Paratype: 1 ♂, "Cal." Fall Coll. (MCZ).

Epicauta occidentalis sp. n.

Identical with *lemniscata* but has the intermediate segments of the antennæ broadened and somewhat flattened and has the outer edge of the anterior tibiæ and tarsi denuded, smooth and shiny. No intergrades have been seen.

Holotype: ♂, Cambridge, Nebraska VII–VIII–21 Morse (MCZ No. 26069).

Allotype: ♀, eutopotypical (MCZ).

Paratypes: NEBRASKA: 6 eutopotypical (MCZ). KANSAS: 1 Abilene (MCZ), 2 Ks.-Liebeck Coll. (MCZ). COLORADO: 5 Rocky Ford (Colo.), 3 Joes (Colo.), 1 Ft. Collins (Colo.). TEXAS: 3 Dallas-Boll (MCZ), 2 Tex. (MCZ). LOUISIANA: 1 Baton Rouge (USNM), 3 La. (MCZ).

Epicauta fortis sp. n.

Resembles *sericans* greatly in general shape and habitus but is consistently smaller than that species, has the antennæ shorter and has the outer spur of the hind tibiæ broad and flattened. Some specimens of *ferruginea* resemble it but they are narrower and have the pubescence coarser.

Holotype: ♂, Phoenix, Arizona, Liebeck Coll. (MCZ No. 26066).

Allotype: ♀, eutopotypical (MCZ).

Paratypes: ARIZONA: 17 topotypical (MCZ), 5 Tucson (MCZ), 1 Picacho (Colo.), 52 Florence (ANSP). NEW MEXICO: 1 Las Cruces (USNM).

Epicauta barberi sp. n.

Black, fairly densely clothed with semi-erect black pubescence. Head and pronotum shiny. The head is much more densely and finely punctured than in *puncticollis* or *oblita.* The outer division of the tarsal claws is curved from the base and the inner division is not more than three-fourths as long as the outer. In *puncticollis* and *oblita*, the outer division is curved near the tip and the inner division is almost as long as the outer.

Holotype: ♂, La Panza, California May 17–18 CCWilson (USNM).

Paratype: 1 ♂ San Luis Obispo, California — May 16–35 CC Wilson (USNM).

Named for Mr. H. S. Barber of the U. S. National Museum.

Epicauta kansana sp. n.

Black, with scattered semi-erect but rather short pubescence, resembling *puncticollis* and *oblita*. Head and pronotum shiny, the head more densely punctured than the pronotum. Tarsi unusually slender. Inner division of tarsal claws as long as the outer but very slender. The outer curves near the tip. Fourth segment of the antennæ longer than the fifth.

Holotype: ♂, Sedgwick, Kansas, June 4, 1910 J. C. Warren (USNM).

Paratypes: 2 eutopotypical (USNM), 2 topotypical, April 7, 1910 Warren (USNM).

Epicauta calcarata sp. n.

Similar to *sericans* in general shape but has longer pubescence, especially on the pronotum. The labrum is deeply excised. The pronotum is noticeably globose. Tibial spurs very stout, especially on the anterior legs, curved. Mandibles long, the tips crossed.

Holotype: ♀, Roswell, New Mexico, Aug., 1902 (MCZ No. 26065).

Allotype: ♂, between Wild Horse and Plateau, Culbertson Co., Texas 2852 ft. Aug. 31, 1937, Rehn, Pate, Rehn (ANSP).

Paratypes: 1 Carlsbad, New Mexico — R&H — Aug. 25, 1921 (ANSP), 1 Dim Lake — Pecos Val. — New Mexico Aug. 21, 1902 (MCZ), 1 Ft. Stockton, Texas 2500 ft. Sept. 1, 1937 RPR (ANSP).

Epicauta aspera sp. n.

Misidentified as "*cinerea*" in most collections. Second to fourth abdominal sternites, sometimes fifth, with a black median spot and with a spot anteriorly on each side near the edge. Male middle and posterior femora denuded behind and with marginal long hair. Actually belongs to the *caviceps* group but does not have the head modified. Uniform above but for a humeral and

scutellar spot on the elytra, sometimes joined across the base.
Holotype: ♂, Salida, Colorado Aug. 13 (MCZ No. 26063).
Allotype: ♀, Jemez Springs, New Mexico (MCZ).
Paratypes: COLORADO: 4 Masonsville (3 Colo., 1 Werner), 5 Ft. Collins (4 Colo., 1 Werner), 3 Boulder (1 Colo., 1 AMNH, 1 Parker), 1 B. Rotger C. R. (Parker), 1 Morison (Colo.), 1 Colo. (Colo.). TEXAS: 4 Davis Mts. (2 Ohio, 1 Parker, 1 Werner). NEW MEXICO: 3 Jemez Spgs. (Frost), 1 Barton — 6700 ft. (ANSP). ARIZONA: 4 Copper Basin — near Prescott (USNM), 1 White Mts. (Parker), 1 Wilmsn. Val. — Ball (Parker).

Epicauta parkeri sp. n.

This and the species that follow fall into the old genus *Macrobasis*, which I have decided to suppress under *Epicauta*.

Resembles *E. gissleri* (Horn) in general appearance. Black, sparsely clothed with cinereous pubescence, which forms denser margins on the elytra. The antennæ are more slender than in *gissleri*, with the segments less distinctly separated. The head is elongate-triangular and the mandibles are as long as in *mimetica*. They go one-third beyond the labrum, cross at the tip and have a distinct tooth.
Holotype: ♀, White Mts., Arizona July 8, 1933 (Parker).
Paratypes: 3 eutopotypical (1 Parker, 2 Werner), 1 topotypical (Parker), 1 San Rita Mts. — Ball (Parker), 1 San Rita Mts. — 5–8000 ft. — July (Snow) (MCZ No. 26080), 1 Globe (Parker), 1 Baboquivari Mts. (MCZ), 1 Flagstaff (Ohio).

Epicauta polingi sp. n.

Three distinct species have been known under the name of *linearis*. None of these is the true *linearis*, which has the first segment of the male antennæ excavated externally at the tip and has the second segment shorter than the third in both sexes. It is a rare species.

Slender. Head and pronotum black or dark brown, the elytra pale ferrugineous, the whole rather loosely clothed with cinereous to luteous pubescence. First segment of male antennæ exceeding the head by one-third its own length, not over one-sixth as broad as long, straight, flattened behind and with cinereous pubescence along this surface. Second segment narrower, elongate oval, about one-third as long as first. The first and second segment together are about equal to the rest in length. Anterior tarsi of male with the first segment short, contorted.

Holotype: ♂, Davis Mts., Texas VI–VII–1928 OCPoling (MCZ No. 26071).

Allotype: ♀, eutopotypical (MCZ).

Paratypes: 6 eutopotypical (MCZ), 18 topotypical VI–VIII–DJ&JN Knull (14 Ohio, 4 Parker), 1 Phantom L. — Davis Mts. (MCZ), 7 Alpine (1 AMNH, 6 MCZ), 4 Sabinal (USNM), 3 Devil's River (USNM), 2 Rio Frio (USNM), 2 Cotulla (USNM), 24 Tex. (MCZ), 1 Texas-Ulke Coll. (Carnegie). NEW MEXICO: 2 Cloudcroft (MCZ), 1 Alamagordo (MCZ). ARIZONA: 1 Sta. Catalina Mts. (USNM), 2 Douglass (USNM).

Epicauta liebecki sp. n.

Head and pronotum black or dark brown, elytra brown, much darker than in *polingi*, margined with denser pubescence. First segment of male antennæ one-fifth as broad as long and the first two segments distinctly longer than the following. Averages smaller than *polingi*. The posterior tibial spurs are more slender than in the other two.

Holotype: ♂, Tucson, Arizona V–25 Liebeck Coll. (MCZ No. 26068).

Allotype: ♀, eutopotypical (MCZ).

Paratypes: ARIZONA: 2 eutopotypical (MCZ), 1 Bowie (MCZ), 1 Ajo (MCZ), 1 Pima Co. (MCZ), 6 Globe (Parker), 6 Congress Jc. (Ohio), 2 Wickenburg (Ohio), 1 Nogales (AMNH), 9 Columbia-on *Prosopis pubescens* (USNM), 1 Tempe (USNM), 1 Lowell (USNM), 3 Sabino Cn.-Sta. Catalina Mts. (2 MCZ, 1 USNM), 1 Sta. Catalina Mts. (USNM), 9 Baboquivari Mts. (MCZ). SONORA: 1 Imuris VI–25–40, on pigweed (USNM).

Epicauta arizonica sp. n.

Uniformly luteous to dull brown, with sparse cinereous pubescence. Eyes larger than in the other two. First segment of male antennæ exceeding head by only one-sixth its own length, a little less than one-fifth as broad as long. First two segments of male antennæ about one-fifth shorter than the rest. Averages smaller than the other two.

Holotype: ♂, Baboquivari Mts., Arizona IX–5–30–23 Fall Coll. (MCZ No. 26062).

Allotype: ♀, topotypical IX–23 (MCZ).

Paratypes: ARIZONA: 4 topotypical (MCZ), 4 Kits Peak Rincon-Bab. Mts. (AMNH), 15 Tucson (Ohio), 1 Wickenburg (Ohio), 9 Nogales (8 USNM, 1 MCZ), 1 Capitan Mt. (Colo.), 5 Canon Lake (Parker), 7 Globe (Parker), 3 San Bernardino Rch.-Cochise Co. (2 MCZ, 1 USNM), 1 Phoenix (MCZ), 1 Rice (MCZ), 1 Sta. Rita Mts. (MCZ). SONORA: 4 Arizpe (USNM).

Epicauta texana sp. n.

Close to *albida* (Say). The first segment of the male antennæ is longer and less curved, narrower, reaching to middle of thorax. Shorter and stouter than *albida*. The black pronotal markings are absent or extremely faint. The abdominal markings of *albida* are always lacking. Eyes narrower than in that species.

Holotype: ♂, Davis Mts., Texas VIII–2–37 DJ&JN Knull (Ohio).

Allotype: ♀, eutopotypical (Ohio).

Paratypes: TEXAS: 9 eutopotypical (Ohio), 3 Alpine VII–20–22 4400–6000 ft. Wickham (2 USNM, 1 MCZ No. 26072), 3 Marfa (Ohio), 1 Texas-Wenzel Coll. (Ohio).

NEW NEUROPTERA AND TRICHOPTERA FROM THE UNITED STATES [1]

By Nathan Banks

In the course of identification of Neuropteroid insects in the Museum of Comparative Zoölogy several species were found that are new. Descriptions of these are given, and further studies with additional material enable one to prepare a synopsis of our small species of Myrmeleon.

Order NEUROPTERA

Chrysopidæ

Chrysopa sperryæ sp. nov.

Pale greenish; head, antennæ, and legs more yellowish; pronotum with a median yellowish stripe, extending back on mesonotum; both pairs of palpi marked with black, otherwise without dark marks, no dark nor reddish on cheeks. Wings with green venation, the only black is on the first (and sometimes second) branch from cubitus to the cubital fork. Stigma long, plainly green.

The fore wings have eleven radial cross-veins, six cubitals beyond the divisory cell, latter ending before cross-vein above; about six inner gradates and seven outer, the rows nearly parallel, each gradate separated from the next by more than its length, except the two or three at upper end of outer row; hairs on veins about as in *C. plorabunda*. The costal area (at broadest) almost as broad as the radial area, and each about equal to the post-cubital area, latter fully one-third broader than cubital area; subcostal area of stigma with but one or two cross-veins.

In hind wings eight or nine radials; three inner gradates, and four or five outer ones, in nearly parallel series, and well separated.

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[1] Published with the aid of a grant from the Museum of Comparative Zoölogy at Harvard College.

Length of fore wing 10 to 12 mm.

From Riverside, Calif. 22 August to 19 September, from Grace H. and John L. Sperry; also two from Lake Arrowhead, Calif., 29 August (Buckwalter coll.). Type M.C.Z., No. 25753.

Readily separated from all others in the *plorabunda* section by the absence of dark or reddish marks below the eyes.

MYRMELEONIDÆ

Vella texana minor var. nov.

Acanthaclisis fallax Rambur was described from "Guyane"; Hagen identified specimens from Mexico as this, and in my Revision of the Myrmeleonidæ (1927) I kept the Mexican and Arizonian specimens under that name. Now I have seen specimens from Guiana, and ours is a different form.

It is in many particulars like *V. texana* Hagen, so I describe it as a variety of that species.

It is uniformly a little smaller, fore wing from 48 to 51 mm. long (*texana* 54 to 56 mm.) but the wing scarcely more narrow; the tip is very plainly less pointed, the hind margin before tip not or scarcely concave (in *texana* plainly so). As noted in my Revision, the venation is more dense, but not as heavily marked. The costal area has a number of cells before middle that are crossed, while in *texana* there are few or none. The markings on body are similar; on pronotum the pale areas are paler than in *texana*, and the dark on mesoscutellum is divided by a fine pale line.

The male appendages of minor are plainly a little shorter than in *texana*.

The type is from Phoenix, Arizona, paratypes from Tucson, 6 to 9 August and 6 September. M.C.Z., No. 25758.

Myrmeleon carolinus sp. nov.

In general much like *M. crudelis* Walker from Florida. It is readily separated by the last joint of labial palpi being much less swollen, and in the male the abdomen is plainly a little longer and more slender. In the female of *crudelis* there is a large triangular pale spot on each side of the last segment of the abdomen, in *carolinus* none or a faint line. The hair on abdomen is fully as long as in *crudelis*. The wings of *carolinus* are not as broad, and the dark marks on veins are not as distinct as in *crudelis*.

The specimens average a little smaller in size than *crudelis*.

Many specimens taken at Southern Pines, North Carolina, by Mr. Manee from the latter part of May until August, also several from Millin, Scriven Co., Georgia, July (Morrison). Type M.C.Z., No. 25752.

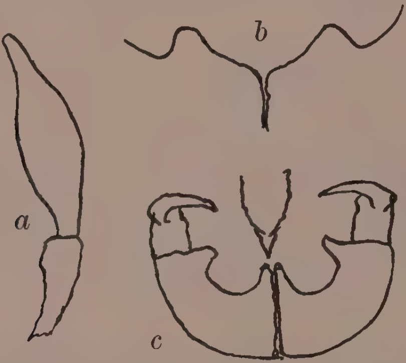

FIG. 1. (a) Labial palpus of *Myrmeleon carolinus*, n.sp.; (b) Base of ♂ claspers from behind of *Banksiola* "*concatenata*" Walker; (c) ♂ claspers from behind of *Banksiola crotchi*, n.sp.

Myrmeleon arizonicus sp. nov.

Head black, except lower clypeus and orbits, antennæ black except part of basal joint, last joint of labial palpi much swollen, black. Pronotum black; in front of groove is a median pale line and each side is a rounded pale spot, and outer margin pale; behind the groove is an elongate pale spot each side, behind the spot in the front part; hair white. Thorax black, hind margin of mesonotum narrowly pale; abdomen black, last five segments narrowly pale at tip above, hair short and white, except that last segment of female has short erect black hair as usual. Legs pale; mid and hind femora largely black, and front femora black below; all tibiæ black within, the front also dark on sides; tarsi, except basal joint black.

Fore wings with longitudinal veins plainly streaked with black; cross-veins pale with dark dots, but in apical fourth of wing they are mostly black; hair short and black; hind wings with similar venation. Wing slender, acute at tips; fore wings with seven cross-veins before radial sector, nine to eleven radials before stigma, five or six branches of anal; one series of gradates in apical costal area. In hind wings four cross-veins before radial sector, about eight radials before stigma, and five branches to anal; no gradates in apical costal area.

Length of fore wing 21 to 25 mm., width 4.9 to 5.5 mm. Length of hind wing 19 to 23 mm., width 4 to 4.2 mm.

From Tucson, Arizona, 6, 20 June; 6 August; Nogales, Arizona 25 July; El Paso, Texas, 4 July, and Brownsville, Texas, April. Type M.C.Z., No. 25849.

In general similar to *M. rusticus*, but smaller on average, with plainly more slender wings, and cross-veins dotted, vertex usually wholly black, and the last joint of labial palpi rather more swollen.

Myrmeleon californicus sp. nov.

Face mostly reddish brown, lower part of clypeus and the orbits yellowish, front and vertex deep black, also the antennæ except part of basal joint. Pronotum pale, markings very faint, behind groove is a large broad dark area, and in front a smaller median spot, hair white; thorax black, pruinose; abdomen black, with short white hair, none of segments pale at tips except the last; legs pale, mid and hind femora somewhat embrowned, mid and hind tibiæ with black line within, all tarsi mostly black except basal joint, spines black, spurs almost equal first joint.

Wings hyaline, veins mostly pale, subcosta, radius, and cubitus marked with dark streaks as usual, stigma white; most of venation beyond stigma dark, and some cross-veins behind are dark; hair on veins in costal area mostly black, elsewhere it is largely snow-white, or only the tips of hairs black. Last joint of labial palpi black, except tip, about as much swollen as in *M. rusticus*.

Wings broad, especially toward tip; in fore wing the apical costal area is expanded in front and just behind the tip of wing is a distinct concavity, so the tip appears slightly falcate. In fore wing seven cross-veins before radial sector, about ten radials before stigma, one series of gradates in apical costal area, six or seven branches of anal vein; posterior part of cubital area almost twice as broad as anterior part; the cubitus beyond the forking curves forward more than in most species; in hind wings four cross-veins before radial sector, seven radials before stigma, no gradates in apical costal area, three branches of anal vein.

Length of fore wing 23 mm.; width 5.8 mm. Length of hind wing 21 mm., width 4.8 mm.

One female from Gavilan, California, 11 July (G. H. &. J. L. Sperry). Type M.C.Z., No. 25850.

Synopsis of the Small Myrmeleons of United States

1. Two series of cross-veins in apical field of fore wings; vertex usually entirely dark; veins with dark dots (or none), no dark streaks on cross-veins . . . . 2.
   But one series of cross-veins in apical field of fore wings; vertex often spotted with pale; cross-veins often partly or wholly dark . . . . 4.
2. Pronotum with a median dark streak, narrowed in front; veins scarcely dotted with dark; legs not marked with black; at most reddish brown . . . . *texanus.*
   Pronotum with a broad dark mark, containing more or less plainly about five pale spots; veins plainly dotted with dark . . . . 3.
3. Last joint of labial palpi much swollen . . . . *crudelis.*
   Last joint of labial palpi slender . . . . *carolinus.*
4. Hair on veins, especially toward tip of wing, largely white; apical costal area expanded in front; cross-veins little marked with dark; vertex wholly dark . . *californicus.*
   Hair on veins black; apical costal area not expanded in front . . . . 5.
5. Radials and many cross-veins dotted with dark, not dark in streaks nor wholly so . . . . 6.
   Radials and most other cross-veins not dotted, but of an even color, usually dark, or dark in streaks . . . . 7.
6. In the hind wings the radius and cubitus at least on basal part are plainly darker than other veins; radial sector also partly dark; mid and hind femora broadly banded with black; scutellum dark; vertex mostly dark; fore wings not 25 millimeters long . . . . *arizonicus*
   In hind wings the radius and cubitus not darker than other veins; mid and hind femora largely yellowish brown; scutellum pale; fore wings fully 25 millimeters long . . . . *rusticus.*

7. In hind wings radius and cubitus darker than other veins; dark spots on clypeus; fore wings over 25 millimeters long . . . . *distans*.
   In hand wings radius and cubitus pale as other veins, most of cross-veins wholly pale; no spots on clypeus; pronotum largely pale; fore wings not over 25 millimeters long . . . . *diversus*.

ASCALAPHIDÆ

Ululodes nigripes sp. nov.

Of the general appearance of *U. senex* Burm. The hair on face much darker, that near base of antennæ dark gray; on pleura just below base of fore wings there is also gray hair (instead of the white); the hair on pronotum almost black, that on mesonotum dark gray; most of the hair on pleura is white, but more gray hair than in *senex*; hair at base of abdomen nearly black. Antennæ nearly evenly black, sometimes a faint dot or narrow line at base of some joints, but not like the broad pale bands of *arizonensis* and *albifrons*, the knob of antenna short and black.

Mid and hind tibiæ and tarsi black (sometimes also front pair), densely clothed with black hair and bristles; femora with mostly long white hair as in other species. In the female the antennæ do not reach to the stigma, about five costal cells before it.

Wings hyaline; in female sometimes a dark stigmal band in hind pair; venation black; stigma black, covering four or five cross-veins. The fore wings are a little broader at middle, and a little more acute at tip than in *senex*.

Fore wing 25 to 26 mm. long.

From Davis Mts., Texas (D. J. & J. N. Knull) in June, July, and August. Type in Ohio State Univ. Collection; paratypes there and at the M.C.Z., No. 25744.

MANTISPIDÆ

Manispa uhleri sp. nov.

Face pale, with a narrow median dark stripe, enlarged on clypeus and on labrum, and also at antennæ where it extends up on front in two dark stripes leaving a pale stripe between them, and extending laterally on vertex to eyes, and also just above antennæ extending laterally to eyes; palpi marked with dark; antennæ brown, basal joint pale yellowish; pronotum pale, with a median black line distinct in front and behind, the side margins of anterior lobe also brown; mesonotum with a broad brown area through the middle, and a brown stripe each side above wing-base, a yellowish stripe each side between the brown; abdomen dark brown to black, the tips of some segments narrowly pale; legs yellowish, front femora and tibiæ dark brown, inner side of femora partly pale, the long spine yellowish, others brown.

Wings hyaline, stigma brown, a pale yellowish-brown streak between the subcosta and radius; venation mostly dark brown to black, toward base of wings some veins are pale.

Structure similar to *sayi* and *cincticornis*; each radial cell with two or three branches.

Length 14 mm.

Holotype from Pennsylvania, 1858 (P. R. Uhler).

Type M.C.Z. 22132. Paratype, Starved Rock, Ill. 4 Aug. (F. G. Werner).

Differs from *sayi* and *cincticornis* in the almost entirely black abdomen, and in that the dark face mark extends upward on front to the vertex.

Specimens from the Field Museum taken at Palos Park, Edgebrook, Lombard, and Dowers Creek in Illinois in July, August, September, and November are paratypes, also from Delaware, Wisconsin. In the females several joints of the antennæ near the apical third are yellowish.

Order TRICHOPTERA

Phryganeidæ

Banksiola crotchi sp. nov.

In general appearance very similar to the common Eastern species which has been considered (but wrongly) "*concatenata*"; the fore wings banded and spotted in the same manner, also the apical part of hind wing is marked as in that species; the venation is also on the same plan.

But the claspers of the male show a striking difference; seen from behind each shows two widely separated processes or teeth, one very slender at the extreme inner end, the other much further out is broader and larger. (In "*concatenata*" so-called there is a broad somewhat triangular lobe or plate near the extreme inner end.) The lateral curved median process is about as in the Eastern species, and the penis is about the same. The superior plate (tenth segment) has the apical indentation much as in the Eastern form, but the lateral lobe or process near its base is much larger.

Length of fore wing 12 mm.

Two males from Victoria, Vancouver Island, July (G. R. Crotch). Type M.C.Z. 25956.

TWO NEW GENERA IN PSAMMOCHARIDÆ (HYM.)

By Nathan Banks

Museum of Comparative Zoology, Cambridge, Mass.

Pompilus nobilis Fab. exhibits an interesting assembly of characters which tend to lessen the differences between the subfamilies of these wasps. The general structure and venation is much as in the Pseudageninæ but there is no true petiole.

Priochilus gen. nov.

The attachment of abdomen to propodeum simply tapers to the base, no petiole. The claws are cleft, there is a median row of spines on under side of last joint of hind tarsus, the hind femora have a few minute spine-pits on upper side near tip; there is no distinct pocket in the third discoidal cell, and no groove on second ventral segment; spines above on hind tibiæ are rather long and not in rows. Genotype, *Pompilus nobilis* Fabricius. There are various other species in South America.

Priophanes gen. nov.

This is based on species formerly placed in Priocnemis which have a petiole, or hour-glass shaped attachment, of abdomen to propodeum, and thus goes into the Pseudageninæ. The hind tibiæ have rows of spines above, and distinct teeth at least on basal part. The venation is much like Pseudagenia; claws toothed; no beard under head; venter of female with a groove across second segment; mesosternum not prominent laterally. Genotype, *Priocnemis facetus* Cresson. Various other species in North and South America.

NOTES ON *DICTYOLATHYS MACULATA* BANKS (ARANEÆ: DICTYNIDÆ)

By Elizabeth B. Bryant

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Recently in examining some material from Raleigh, North Carolina, collected in January 1941, two females were found described as *Dictyolathys maculata* Banks. This genus, erected by Banks in 1900, was based on females from Mobile, Alabama, and Meridian, Mississippi, and was separated from *Lathys* by the strongly procurved anterior eye row.

In 1903, Simon, who had never seen a specimen, placed the genus as a synonym of *Lathys* and was followed by Emerton, in 1913. He described and figured the male from specimens collected May 1, 1912 at Lakehurst, New Jersey. At the end of the description, Emerton says, "In the original description of *Dictyolathys maculata*, Banks says that the front middle eyes can be indistinctly seen but I have not been able to find them in the Lakehurst specimens nor in the (Banks) type specimen from Alabama. They appear to have only six eyes in two groups as in *Scotolathys pallida*."

Today with the sharp light from a condenser, the small anterior median eyes seen by Banks can be distinctly placed both in the type and the specimens used by Emerton, as well as in the recent material from Raleigh, so that the Banks genus *Dictyolathys* can no longer be considered a synonym either of *Lathys* or *Scotolathys*.

For the benefit of those who do not have ready access to the original description of *Dictyolathys* Banks, I quote verbatim as follows:

"Much like *Dictyna*, but apparently six-eyed, three in a group each side but the A.M.E. are present, although very small, and situated close to and a little higher than the A.S.E. Head not much elevated; legs of moderate length, no spines, but very hairy; accessory spinning organs like *Dictyna*."

A more detailed description of the genus can now be written to include other characters not used by Banks in the original description.

Genus **Dictyolathys** Banks

Proc. Philadelphia Acad., 1900, p. 534.

Cephalothorax moderately high, no thoracic groove; eight *eyes*, lateral eyes on a low tubercle, a.m.e. very small on the posterior slope of the tubercle, widely separated, so that the anterior row of eyes is strongly procurved, posterior row slightly procurved, p.l.e. largest of the eight; *clypeus* equals a radius of a.l.e.; *labium* triangular, as long as wide; *sternum* convex, almost as wide as long, ending in a lobe between fourth coxæ; legs varying little in length, fourth pair longest, no spines, dorsal row of trichobothria on fourth tibia; calamistrum confined to basal half of fourth metatarsus.

Dictyolathys is separated from *Lathys* by the strongly procurved anterior eye row, and the p.l.e. larger than the p.m.e., and from *Scotolathys* by the presence of small a.m.e. and the large p.l.e.

The genus *Lathys* Simon, 1884, was based on the species *humilis* Blackwall, common to northern Europe. This has eight eyes, with the anterior row straight, eyes contiguous, a.m.e. very small, posterior row slightly procurved, eyes equal and usually equidistant.

The genus *Scotolathys* Simon, 1884, was erected for a species, (*simplex*) from Algiers, with but six eyes, the a.l.e. the largest of the eight. In both Les Histoire Naturelle des Araignées, 1903, 2, p. 977 and Les Arachnides de France, 1914, 6, p. 62, Simon has placed *Lathys heterophthalma* Kulczynski, 1891, in the genus *Scotolathys* but states that the a.m.e. almost obliterated. No specimens of this species are in the museum collection; but in the original description, "♀ Oculorum; series posterior paullo procurva, oculi magni, inter se subæquales et spatiis parum inæqualibus, circiter radium æquantibus remoti; series anterior subrecta, oculi valde inæquales, mediorum diameter radio lateralium minor, oculi laterales posticis subæquales, medii inter se late (plus quam diametro sua) distantes, lateralibus valde approximate." Having regard to this and the figures, it would seem that Kulczynski was correct in placing the species in the genus *Lathys*.

Dictyolathys maculata Banks

Figure 1

Proc. Philadelphia Acad., 1900, p. 534.

Female. Length, 1.5 mm.

Cephalothorax moderately convex, cephalic portion level, with a median row of very long bristles from near the posterior margin to eyes, thoracic portion falls rapidly to posterior margin; *eyes* in two groups that do not cover the anterior margin, anterior row strongly procurved, lateral eyes on a tubercle, a.l.e. separated by a diameter, a.m.e. very small, on posterior slope of tubercle, posterior row procurved, p.l.e. largest of the eight, separated from a.l.e. by a line and from p.m.e. by less than a radius, p.m.e. separated by about a diameter; *quadrangle* of median eyes much narrower in front and as high as wide behind; *clypeus* as high as radius of a.l.e.; *mandibles* small, verticle; *labium* triangular, with tip black, not fused to sternum; *maxillæ* inclined over labium with tips almost touching; *sternum* pale, strongly convex, only slightly longer than wide, ending in a lobe between IV coxæ, IV coxæ widely separated; *abdomen* oval, pale, with a small median basal black spot, followed by five pairs of diagonal black spots, sides with black streaks, venter pale; *legs*, pale, relatively short, varying little in length, but the IV pair longest, no spines, a dorsal row of trichobothria on IV tibia; calamistrum of curved bristles, less than the diameter of the joint in length, on basal half of IV metatarsus; *epigynum* large for the size of the spider, chitinized area wider than long, with openings widely separated, and a pale depressed area just anterior to openings.

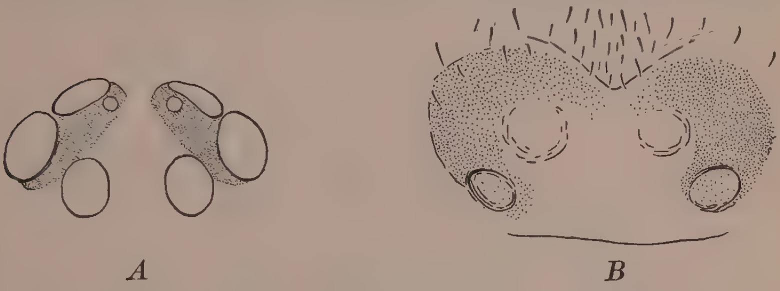

FIG. 1. *Dictyolathys maculata* Banks. A, eyes; B, epigynum.

Dictyolathys maculata Banks has been reported by Bishop and Crosby in 1926, from Madison and Raleigh, North Carolina and by Gertsch and Mulaik in 1940, from Houston, Harris Co., Texas.

Material in the Museum of Compartive Zoölogy Collection:
Holotype Ala.; Mobile, Banks Coll.
2 ♂ N. J.; Lakehurst, 1 May 1912, Emerton Coll.
2 ♀ N. C.; Raleigh, oak woods, 23 January 1941, (Wray).

In 1904, Banks described *Dictyolathys californica* from Palo Alto, California, also from a female. Unfortunately, this specimen cannot be found in the museum collection, but from the description and the figures, it probably does not belong to the genus *Dictyolathys* since the small a.m.e. are only a diameter apart; the anterior row is almost straight as in *Lathys* and the other eyes are subequal.

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THE NEARCTIC FORMS OF LYCÆIDES HÜB. (LYCÆNIDÆ, LEPIDOPTERA)[1]

By V. Nabokov

Museum of Comparative Zoölogy

What follows is a brief summary of some conclusions mainly relative to the classification of the American forms of *Lycœides* Hübner, 1823 (Plebejinæ). This genus comprises at least half-a-dozen structural (genitalic) unities which may be termed species, and a full account of its morphology will be published in due time. Except in one inevitable case, no new names are introduced, as it is felt that further study might result in some equilibrium of the variational scheme in *Lycœides*, so as to avoid a chaotic accumulation of poorly balanced "subspecies."

Owing to the abundant Holarctic material in the Museum of Comparative Zoölogy, and thanks to generous loans from the American Museum of Natural History and from private collections (I have especially to thank Mr. H. K. Clench and Mr. Don B. Stallings), a considerable number of specimens could be examined; of these, some 350 were dissected and measured.

Three specific categories may be distinguished as affecting the classification of the Nearctic forms:

argyrognomon Bergsträsser, 1779, Nomencl. 2:76 (Tutt, 1909, Brit. Butt. 3 pl. 50, fig. 2, male genit.; *argus* [L.] Hübner, [1800], Samml. europ. Schmett. fig. 316, male; Scudder, 1872, 4th Ann. Rep. Peabody Acad. Sci. **1871**:54; Reverdin, 1917, *in* Oberthur, Et. Lép. Comp. **14** pl. 1, 2, fig. 1, 1a, male genit.; *idas* L [*nom. prœocc*], *auct., pro part.; non argyrognomon* Beuret, 1935, Forster, 1936).

scudderi Edwards, 1861, Proc. Acad. Nat. Sci. Philadelphia, **1861**:164 male; Scudder, 1889, Butt. N. Engl. 2:967, line 22; Stempffer, 1933, Bull. Soc. Ent. France **102**:110, 111, fig. 1, male genit.; *non scudderi auct.* [nec female *scudderi* Edw., 1861, l.c. = (*Agriades*) *aquilo* Boisduval, 1832]

melissa Edwards, 1873, Trans. Amer. Ent. Soc. 4:346 (Mead, 1875, Rep. Lep. Colorado etc.:783, pl. 36, fig. 5, 6, male, 7, 8, female; Chapman, 1917, *in* Oberthur, Et. Lép. Comp. **14**, pl. 9, fig. 25, male genit.).

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Besides being dissimilar both in specific expression of generic external variation and in the basic shape of the male armature (e.g., the "retroussé" spur [processus superior of the valve] in *argyrognomon*, the spare tapering weakly hooked falx in *melissa*) these three unities are separated throughout the numerous forms that cluster around the three peaks of speciation by constant relations between certain parts of that organ when its dorsum is viewed from below. If F ("forearm") denotes the length of the falx from its distal point to its elbow; H ("humerulus") the length of the falx from elbow to shoulder point; and U the length of the uncus lobe from its tip to the shoulder of the falx, then the following three categories can be formulated:

(1) argyrognomon: H greater than U, F/H smaller than in (2)
(2) scudderi: H equal to U, F/H smaller than in (3)
(3) melissa: H smaller than U.

The Palearctic and Nearctic forms of *argyrognomon* are not only absolutely conspecific, but in one or two cases are strikingly alike exteriorly. *Argyrognomon* was presumably derived from a form of which the Central Asiatic *agnata* Staudinger, 1889, is the closest image to-day. *Scudderi* and the Asiatic *cleobis* Bremer, 1861 (?*subsolanus* Eversmann, 1851 [2]) are, except for a more robust build in the *cleobis* organ, practically identical in genitalic structure (and share at least two peculiar underside characters), but either have not been in touch for a longer time or are coincident species *i.e.*, separately evolved from initial *argyrognomon*-like structures (*scudderi* decreasing in the *argyrognomon* H while *cleobis* arrived at the same proportional result by an increase in the *argyrognomon* U). We find these two on parallel lines which after passing through two coincident stages have widely diverged to produce *melissa* on one hand and *ismenias* Meigen, 1830 (Heydemann, 1931; *insularis* Leech, Verity, 1921, *nec* Leech) on the other. This scheme of course is not a phylogenetic tree but merely its shadow on a plane surface, since a sequence in time is not really deducible from a synchronous series. What seems certain, however, is that *scudderi* in its actual structure stands about midway between *argyrognomon* and *melissa* — somewhat closer perhaps to the former than to the latter.

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[2] Eversmann's type of *subsolanus*, if it still exists, should be examined: his lucid description (grotesquely mistranslated by Rühl and thus copied by Seitz) seems to me to fit quite exactly the species known as *cleobis* Bremer.

The *Lycæides* variation in color and pattern as expressed in more or less constant races of each species can only be briefly alluded to here. Its scope in regard to the male upperside does not seem so wide in the American *argyrognomon* and *scudderi* as it is in the palearctic *argyrognomon* and *cleobis*, in both of which the upperside may be, racially, almost or totally devoid of optical scales, thus leaving the richly pigmented fuscous surface intact. In the nearctic groups, both in *argyrognomon* and in *scudderi*, the optical spread transcends at least the subterminal limit so that the insulæ of the secondaries (the silhouetted in fuscous pigment counterparts of the underside præterminal spots), if not circumviated more or less completely by the violet blue, are left sometimes encased in a slightly less compact fuscous which the eye sees as a thick, sometimes crenulated, "black border." The effect of crenulation may be enhanced by the strong development of terminal triangles and cilian markings in both these species as well as in *ismenias*. In *melissa* the blue extends at least to the circumviating stage but more often swamps the insulæ to reach a terminal limit (that last bulwark of tenuous fuscous which is not crossed in any Blue) so that on the upperside the male *melissa* may be said to be (as far as is known) the least variable of the polymorphic Lycæides species.

On the underside, however, all three pass through a gamut of coloration just as wide as in the palearctic forms. Each of them goes racially from the nearest approach to the basic pigmentation of the upper surface, namely from brown or brownish fawn, through fawn, pale fawn and greyish fawn, to greyish and almost pure white. If a combination of characters does not produce in both sexes some striking and constant aspect in a more or less extensive population, and insofar as tangible objects, and not ecological or other causalities, should receive systematic names, it seems to me quite useless to separate a series of, say, pale underside Yakima *melissa* from equally pale Nevada series, or a darkish underside Texas series from a similar one collected in Saskatchewan.

The rhythms in the pigmentation of the spots, in the spread of the underside optical scaling and in the structure of the marginal ornamentation[3] cannot be treated here; but a few words in regard to the disposition of the extradiscal series as I understand it may be of use. What we see as a transverse, more or less sinuous "line" or "row" of spots seems to me to be the outcome of two unrelated phylogenetic phenomena. The "upper" part of the "row" (from the last radial interspace to the last median one) is formed by spots having radiated fanwise from the discoidal owing to an apicoid extension of the wing texture; the "lower" part (spot in Cu_1 and the two Cu_2 spots, separated by the memory of an A_1 nervule) have been pulled out from a subcellular position (in the proximal corners of their respective interspaces) presumably by a cubitoid extension which did not necessarily occur at the same time as the other. Had not a third phenomenon taken place — namely the appearance and expansion of subterminal ornamental markings ("caudæ pavonis") which held the advancing spots at bay — the latter might have gained the practically præterminal position which they reach in some *Glaucopsychinæ*. This is why the classical conception of a row of ocelli as the result of a statically placed line or band having broken up into spots, seems to me absolutely irrelevant to the understanding of the Lycænidæ pattern. Insofar as spots have been evolved in this family, they occupy different positions in different species or genera, and what we see is not the remnants of a definite band in a definite place, but this or that stage of a more or less coordinated longitudinal movement of spots distad along the interspaces (certain comet-tail traces of this progress are sometimes caught and fixed aberrationally). In a word it is not a row of squares on a chessboard, but a shifting line of attacking pawns.

Lycæides argyrognomon Bergsträsser

As represented by my material, the nearctic *argyrognomon* forms, contrary to those of *melissa*, may be for convenience's sake divided into groups A and B ("white underside" and "fawn underside") and each may be subdivided again into 1 and 2 ("weakly marked" and "strongly marked"). A1 to A2 is expressed by *argyrognomon anna* Edwards, 1861 (Proc. Ac.

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[3] The latter shows a tendency towards obliteration throughout the Nearctic *Lycæides* — a feature unknown racially (except perhaps in the case of the Corsican *argyrognomon bellieri* Obthr) among western Palæarctic forms and paralleled only by certain Central Asiatic ones.

Nat. Sci. Phil. 1861: 163; Strecker, 1874, Lep.: 88, pl. 10, fig. 4, male, fig. 5., female; Stempffer, 1933, Bull. Soc. Ent. France 102: 111, fig. 2, male genit.).[4]

"Typical" fairly weak *anna* is represented by series from California (seven stations), Nevada and Oregon. A stronger *anna* comes from "Glacier Pt." (it is figured by Wright, 1906, Butt. W. Cst, fig. 384, *anna*), and a form of *anna* with all markings as well developed as in any *Lycæides* is provided by a pair from "Pt. Arena," Mendocino Co. What I suppose is *ricei* Cross (1937, Pan-Pacific Ent. 13:88) is represented by a small, very weak underside *anna* form with a uniformly brown female from Oregon ("Kirk") and by a series without locality data mislabeled "*annetta*." A form from "Yakima R." and another from "Vancouver Isl." may be also placed under *anna*.

The other, B group with fawn or whitish fawn underside, represented by long series, has apparently never been detected before and may eventually require a subspecific name to counterbalance the *anna* group. Of B1 I have a series from Washington ("Brewster"): these specimens, if I am American-minded, look like unusually dingy or dusty underside "*anna*" and if I am European-minded, curiously resemble certain weak Swiss forms. Of B2 I have series from Brit. Col. ("B.C.," "Fernie," "Cranbrook," "Michel," "Landsdowne") and from Alberta ("Calgary," "Didsbury," "Carbon," "Laggan"), darkish "black-border" specimens (see above, discussion of *Lycæides* pattern), with an underside resembling series of *argyrognomon singularis* Heydemann, 1932, and other strong W. European races.

Lycæides argyrognomon, trans. ad **scudderi** Edwards

I have not yet examined Edwards' specimens of *kodiak* Edwards (1870, Trans. Am. Ent. Soc. 3:20). Judging by its O.D. and the colored photographs professing to illustrate it (Wright, 1906, *op. cit.*, fig. 365; Holland, 1930, Butt. Bk. pl. 66, fig. 14, 15), it seems somewhat similar to what I have as "*kodiak*" from Alaska ("McKinley").

In this series a twofold individual variation (on the general basis of a dingy underside tone with faint dull fulvous lunules) easily allows the eye to sort out the "*argyrognomon*" and the "*scudderi*" specimens. Genitalically they do represent these two species but the twofold variation mentioned is shared by examples of structural *argyrognomon* and structural *scudderi* in such a way as not to correspond to the definite specific differences in the valve and the falx; so that not only are they inseparable by the shuttling external characters, but all the examples look as if they belonged on the whole to one "arctic" race of one and the same species. Here we put our finger on something very like the actual evolution of *scudderi* from *argyrognomon*, and I have discovered an analogical case in the Palearctic, where *cleobis kenteana* Staudinger, 1892, (?*ida* Grum Grshmaïlo, 1891)[5] is linked up with a most interesting (undescribed) "black" form of *argyrognomon* from North-Eastern Asia. Otherwise, throughout their nearctic distribution wherever a *scudderi* form comes from the same locality as an *argyrognomon* one, both series are correctly separable at a glance. On the other hand in the case of forms from widely separate regions, such as the distinctly marked Glacier Pt. form of *argyrognomon anna* and the ridiculously similar talcum white underside *scudderi* from Riding Mts., Manitoba (kindly loaned me by Dr. Gertsch of the Am. Mus. Nat. Hist. and by Don B. Stallings), the two can be distinguished externally only by the wider terminal space in the former.

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[4] In the case of this form, as in that of the *nom. sp. argyrognomon* and *melissa*, I give only the most pertinent bibliographic data. A fuller synonymy, as well as complete data and acknowledgments in regard to the series of specimens mentioned here, will be given in the main work.

Lycæides scudderi Edwards

scudderi Edwards.

The types are lost. The name is precariously poised on the brink of synonymity into which it is drawn by the alien *aquilo* female. The type locality is not the vague "Lake Winnipeg" as given by Edwards, but the more Western "mouth of the Saskatchewan" mentioned by Scudder who took the type specimen there in 1860. I find it just possible however to save the name by applying it to the *Lycæides* species the organ of which was figured by Stempffer in 1933 (from a Brit. Col. specimen). Up to now it has been confused by all authors with the Eastern subspecies of *melissa*, Ontario specimens of which Edwards misidentified as his *scudderi* in 1862 (Proc. Acad. Nat. Sci. Philadelphia 1862:225).

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[5] I question the accepted identity of *kenteana* Staudinger with Grum Grshmaïlo's *ida* from Amdo.

Most of the Northern specimens are greyish, whitish-grey or white on the underside, but in some cases, when sympathetically examined, or when the whitish bloom has worn off, may be said to fit in with the "dark grey" of Edwards' very poor description.

scudderi scudderi Edw.

Male. Upperside: rather strong terminal line; discernable insulæ in secondaries. Underside: greyish; fuscous spotting delicate but fairly distinct; white arches ray-like in secondaries, i.e. separated throughout by the greyish ground along the vein (a character not represented in my *melissa* material) and fused with the extradiscal halos; fuscous arches on both wings fairly strong, though not distinctly pointed; fulvous arches weak, thin, disconnected from præterminal spots (a character found also in "weak" specimens of *argyrognomon anna* and in some *melissa annetta*) by the ground which is quite whitish towards the termen; præterminal spots in secondaries touched up with ("aquamarine") optical scales conspicuous only in Cu_1 and anally; quite strong terminal line with well-developed triangles and cilian points. [Extradiscal spot in Cu_1 aberrationally distended as it was in Edwards' type specimen.]

Male, neotype, "Saskatchewan. Kennicott." Slide No. 168. Mus. Comp. Zool.

This description holds good for most Northern individuals of *scudderi scudderi* (except that the iridescence may develop in a greater number of spots and that the ground may be quite white throughout with a pale blue dusting of basal optical scaling). Northern females are generally "blue" with, if at all, weakly developed fulvous arches, upperside. My material comes from: Saskatchewan ("Narlan"); Manitoba ("McCreary," "Beulah," "Riding Mts."); Minnesota ("Pequot," "Arrowhead Trail"); Brit. Col. ("B.C.," "Atlin," "Heffley Ck."); Alberta ("Foothills," "Banff," "Jasper"); and Yukon ("White Horse," "Mayo"). If, as I believe, the Yukon insect figured by Gibson (1920, Rep. Can. Arct. Exp. 3, pl. 3, fig. 15, male) is a specimen of *scudderi scudderi*, then it is its first and only representation.

From "Mt. Rainier," Washington, I have a series of remarkable *scudderi* specimens expressing the same variation as *annetta* does for *melissa* and as *ricei* (if correctly identified) does for *argyrognomon anna*. Underside: shiny pale greyish white with conspicuous pale blue basal scaling in secondaries and quite distinct extradiscal spotting in primaries, but with an almost total lack of all other markings so that except for a gleam of aquamarine and a hint of fulvous in the cubital interspaces the secondaries seem quite spotless to the naked eye.

Eastward from Manitoba, presumably through Northern Ontario and Quebec, *scudderi scudderi* intergrades into a Labrador form which differs from the typical mainly in a reduction of size. This is probably the *scudderi* of Möschler (1874, Ent. Zeit. Stettin 35:155–156) which judging by that author's naive but clear description is not the "*scudderi*" of Scudder although of course the latter form may reach much further North than is so far authentically known. Of this small *scudderi* (generally labelled "*aster*" in collections) I have Labrador specimens from "Hopedale" and "Sawbill." Whatever may be the "*aster*" from "Labrador" the armature of which is figured by Chapman (1917, *op. cit.* pl. 15, fig. 45–46), it belongs to *melissa*. The Newfoundland *aster* Edwards, 1882, Can. Ent. 14:194–195 (1898 Holland, *op. cit.*: 266, pl. 30, fig. 40, 46, 47) is presumably the same Little Blue Argus that had been discovered on Carbonear Isl. by Gosse in 1834. Of this I have only two (white, sparsely but distinctly spotted underside) females ("Salmonier") which until I see the types I cannot assign to *scudderi*. Of the Nova Scotian *empetri* Freeman (1938, Can. Ent. 70:62; et 1943, *ibid.*, 75:37), which shows in the underside a striking development of the fuscous spotting upon a greyish-fawn ground, I have as yet only dissected one paratype (Clench Coll.) and in this specimen one important genitalic character seems about to slip out of the *scudderi* specific series.[6]

scudderi lotis Lintner.

(1878, 30th Rep. N. Y. St. Mus. Nat. Hist. 1876:169; *non lotis* Lintn. *auct.*)

Under this name I propose to group various integrading forms of the Southern *scudderi* section. They all disclose on the underside a neater development of the *caudæ pavonis* and, in some cases, an inclination to fawn in the ground color. In other words they approach nearer to the conventional type of the Lycæides, although generally the exiguity of the ornamental band and the *scudderi* character of the white arches give them away. *Lotis* Lintner, which has nothing to do with the *"lotis"* figured by Wright, Barnes-McDunnough, Comstock and Holland (in the case of Wright, 1906, *op. cit.*, fig. 387, it is a male *anna* coupled with the female of a not even congeneric species, and in the case of Holland, 1930, *op. cit.*, pl. 66, fig. 18–20, a fairly typical *melissa*), seems to be known only in two specimens: a female labelled "L. Lota Lintn. 5668 Type" in the Lintner coll., which is an unquestionable *scudderi* female of the more Southern "brown" sort, and a male labelled "4878 Mendocino, California" and "No. 6139 coll. Hy. Edwards Lyc. Lotis Lintn." in the Amer. Mus. Nat. Hist. This unique male, except for showing a trace of fulvous subterminally, in the primaries underside, fits in exactly with Lintner's really admirable description. The data he gives is: "Mendocino, California. Two examples. Coll. of W. H. Edwards." The male type is apparently lost. The Hy. Edwards specimen is the one mentioned (but not figured) by Barnes and McDunnough (1916, *op. cit.*: 169, lin. 12, 13), and having dissected it I found as expected from its appearance, that it was conspecific with *scudderi.*

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[6] Dr. T. N. Freeman has very kindly provided me now with a number of specimens of *empetri*. Although connected specifically with *scudderi*, it exhibits certain curious (reversional?) characters echoed by the most primitive of the Central Asiatic forms.

I have various forms of *scudderi lotis*, from Idaho ("Heyburn Pk"), Montana ("Martina," "Uranus Peak"), Wyoming ("Yellowstone," "Jackson Lake," "Jackson Hole"), Colorado ("Telluride," "San Isabel Forest") and "?N.M." The Jackson and Telluride series have a curious increase in the F suggestive of a slight approach to *melissa* though otherwise typical *scudderi.*

"Black border" (see p. 89) specimens (i.e. similar in this to the Alberta and B. C. *argyrognomon*) are referable to *atrapræ-textus* Field (1939, Journ. Kansas Ent. Soc. 12(4):135). I have such dark specimens from Idaho ("Priest R.") and Montana ("King's Hill"), with intergrades. In the case of *scudderi* the interest of this variation lies in its producing the nearest approach known to a lightish form of the normally very dark *cleobis* Bremer (from Sayan Mts.).[7]

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[7] Other Palearctic forms (all from Turkestan) which reveal a *scudderi* armature (but have been assigned to *ismenias*) are: *dschagatai* (? Grum Grsh., 1890) Stempffer, 1931; *ægina* (? Grum Grsh., 1891; *nec* Leech, 1894, *nec* Seitz, 1909, *nec* Oberthur, 1910) Forster, 1936, and *buchara* Forster, 1936 (? *dschagatai* Grum Grsh.).

Lycæides melissa Edwards

Melissa is the commonest and most widely distributed nearctic Lycæides, or more exactly its structure seems to be the most popular achievement in the genus. There is some indication that in some form or other it reaches Labrador in the North-East. For the Palearctic, it has been reported from the Lower Volga (as *sareptensis* Chapman, 1917, *in* Oberthur, *op. cit.*, 14, pl. 12, male genit., *et* 1918, Ent. Rec. 30:2–5) on the basis of specimens collected by Sheldon and Jones (Sheldon, 1914, Ent. 47:273); the authenticity of the locality data has been criticised by Stempffer, 1931, who however was only aware of the brief mention of *sareptensis* in the 1917 paper. A pair of specimens has also been reported from Kamchatka by Forster (1936, Mitt. München. Ent. Ges. 26:81, slide 418, male genit.) and this might seem fairly plausible had not Forster's work been full of the most preposterous blunders.[8]

melissa melissa Edw.

Although different shades of underside coloration can be racially perceived, the intergradation is so complete and geographically so intricate that I do not hesitate to group all such specimens which only differ in the shade of fawn, from brownish fawn through greyish to almost white, under *melissa melissa.* I have series of this from nineteen stations in Colorado, eleven in California, six in Utah, five each in Idaho, Montana and Manitoba, four each in Washington and British Columbia, two each in Nevada and Wyoming, and from single localities in Saskatchewan, Alberta, Oregon, Arizona, Texas and Kansas.

My material shows that at four points of its extensive Western range *melissa* produces four striking local races embossed as it were on its rather monotonous morphological texture. These are:

1. A curious Colorado form from Pitkin Co. and Lake Co. which, owing to the narrowness of the underside ornamental band, bears a false resemblance to *scudderi.* Possibly referred to by Barnes and McDunnough *op. cit.*: 110.
2. A darkish form with discernible insulæ and a peculiar underside: hoary greyish fawn with a generous spread of pale

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[8] Such as assigning an alien *Lycæides* organ (Mitt. Münchner Ent. Ges. 26, slide 493) to *Plebejus argus* ssp. *tancrei* Græser (l.c. fig. 27) or confusing *Lycæna anna* Edwards with *Thecla anna* Druce (l.c.:141), etc.

greenish-blue dusting from base in secondaries and very large golden-green præterminal blotches. From Gold Lake and Mammoth Lake, California. Figured by Comstock, 1927 (Butt. Calif., Pl. 53, Fig. 21, *melissa* female).

3. A showy, rather light lilac blue form with a white underside, well developed and sometimes quite separate orange lunules, and a florid female. From several districts in California ("Bouquet Cn," "Owens Lake," "Tehachapi"; also apparently "Arrowhead," "Olancha," "Lebec"). This race is the "*lotis*" of authors (Barnes and McDunnough, 1916, *op. cit.*, pl. 11, fig. 12, male; Comstock, 1927, *op. cit.*, pl. 53, fig. 23, 24, male, 25, female; Stempffer, 1933, Bull. Soc. Ent. France 102:110).

4. *melissa annetta* [Mead in litt.] Edwards, 1882 (Papilio 2:48–49; Holland, 1898, *op. cit.*: 266–267, pl. 32, fig. 13, male, 14, female; et 1930, *ibid.* pl. 66, fig. 16, male). Sparse, weak or obsolescent markings on white ground of underside; pale greyish blue female. In 1943 I travelled to Utah with the express object of obtaining this little known form and found it in fair numbers, though very local, on lupine among firs at 9,000 ft. near Alta in the Wasatch Mts. A full account of its habits will be given later. The male armature is quite similar to that of the typical *melissa* which occurred at about 6,500 ft., some ten miles nearer to Salt Lake City (with intergrades especially in females cropping up among the *annetta* population). In some of the *annetta*, however, there is a slight increase above the *melissa* average in the H of the otherwise typical *melissa* organ, and this, together with a *scudderi lotis* aspect of some of the specimens, tends to diminish the hiatus between *melissa* and the Wyoming form of *scudderi.*

The production of such local forms with more or less fluid edges is characteristic of the other species too, but in one respect *melissa* seems to be unique among its American congeners, and, namely, in that it is completely replaced East of the Mississippi (from at least Southern N. Carolina to at least Ontario) by a remarkably constant form which might serve as an example of how a really good subspecies ought to behave. It is the best known *Lycæides* in America, but lacks a name.

Lycæides melissa subsp. **samuelis** nom. nov.

(*scudderi* Edwards, Scudder, 1889, Butt. N. Engl. 3, pl. 6, fig. 6, male, pl. 34, fig. 29, male genit., *non scudderi* Edw.;

Holland, 1898, Butt. Book, pl. 30, fig. 48, male, fig. 49, female, *et* 1930, *op. cit.* pl. 66, fig. 12, male,[9] *non scudderi* Edwards, *nec* "type"; *melissa* Edwards, Chapman, 1917 *in* Oberthur, *Et. Lep. Comp.* 14, pl. 9, fig. 26, male, genit.; *et* 1918, Ent. Rec. 30:4).

Distinguished from all *melissa* forms by the following combination of characters: ampler (cubitoid) termen, especially noticeable in female. Upperside: optical scaling producing a duller violet effect in both sexes. Fulvous arches in female generally restricted to the secondaries and to the strong interspaces. Underside: colder tone of greyish fawn coloration which produces, in spite of the pronounced halos around the well-pigmented extradiscal spots, a uniform effect (recalling certain palearctic *Plebejus* species), this effect being due both to the broader wing space and to a peculiar reduction of the white arches which form mere rims to the thin fuscous arches (this distinguishes it also from *scudderi*); narrowness of subterminal ornamentation in contrast to spacious disc; spot in Cu_1 generally placed in a more distad advanced position due presumably to cubitoid wing shape, and thus not forming with the discoidal and the $Cu_2+(A_1)$ spots a regularly slanting line as it does in most individuals of other *melissa* forms. Genitalically shows the highest differentiation of the *melissa* male organ from that of *scudderi*, in all specimens measured the fraction H/U being even smaller than is usual for most *melissa* forms (see p. 88).

Male, holotype, labelled "Orig. Pl. 6, fig. 6, Butt. N. Engl. Cab. S. H. Scudder, 306," Mus. Comp. Zool. Slide No. 338. Genitalia measurements: F=0, 57mm., H=0, 35mm., U=0, 44mm. Female, allotype, labelled "Albany N.Y." ex coll. Scudder, Mus. Comp. Zool. Paratypes: 5 males, 1 female, "Albany N.Y."; 1 male, 1 female "Centre N.Y."; and 1 female "Canada, Saunders." [London, Ont.], all these ex coll. Scudder, Mus. Comp. Zool.; 2 males, 1 female "Centre N.Y.," 1 female "Detroit, Mich."; 1 male, 1 female "Pa." and 2 males, 1 female "N.Y. State," all these in Mus. Comp. Zool.; 22 males, 12 females "Albany N.Y." coll. H. K. Clench; 1 male "Albany, N.Y.," 6 males "Sylvania, Ohio" and two pairs "Toronto, Ont."

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[9] Dr. W. R. Sweadner of the Carnegie Museum, where this specimen (coll. Edwards) is preserved, obligingly sent me a replica of the locality wiggle. It reads: "N. York."

coll. Don B. Stallings; four pairs "Albany, N.Y.," two pairs "Karner, N.Y., 1 male "Massach ex coll. Angus," and 2 females "Mass. ex coll Hy. Edwards ["from W. H. Edwards" — W. P. Comstock *in litt.*], Am. Mus. Nat. Hist.; one pair each "Sylvania, Ohio," "Ness Lake, Mich." and "Toronto, Ont." coll. T. N. Freeman and one male, two females "Nashua, N. H." coll. W. P. Comstock.

TWO NEW INDIAN EMBIOPTERA AND THE LECTOTYPE OF *OLIGOTOMA BORNEËNSIS* HAGEN [1]

By Edward S. Ross

California Academy of Sciences, San Francisco

Embiidæ

Metembia flava Ross, new species

(Figures 1 to 5)

Holotype male (on slide): *Color* — pale yellow throughout, head and thorax somewhat darker, wings light brown, abdominal terminalia with tenth tergite and basal segment of left cercus tan. *Dimensions* — length 7.5 mm.; fore-wing length 3.57 mm., breadth 1.0 mm.

Head (fig. 1) with form as illustrated, very weakly pigmented throughout except the mandibles which have golden-brown apices.

Wings with hyaline stripes very broad, margins ragged. R_1 nearly attaining wing apex, slightly curved toward R_{2+3} and R_4.

Hind basitarsi (fig. 5) with two conspicuous sole-bladders.

Terminalia (figs. 2 to 4) with left tergal process (10 LP) small, short; form as illustrated (fig. 3). Right hemitergite (10 R) with a cone-like caudal projection (10 RP_1) which terminates as a minute sclerotic point; secondary process (10 RP_2) represented as a long, longitudinally folded, submembranous area closely paralleling inner side of 10 L and terminating as a small rounded lobe. Hypandrium (H) scarcely pigmented, outline inconspicuous, quadrate; caudally produced medially as a short, broadly rounded lobe (HP). Composite left cercus-basipodite and left paraproct (LCB + LPPT) with caudal margin somewhat sclerotized, posterior angle with a roughened, pigmented lobe. Composite right paraproct

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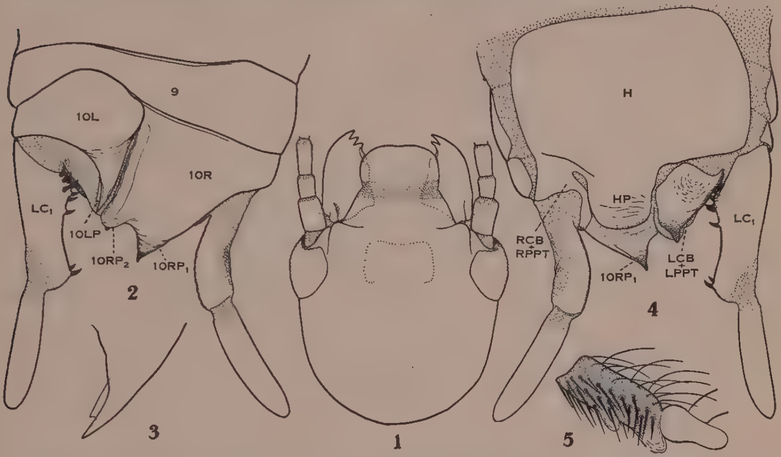
[1] Published with the aid of a grant from the Museum of Comparative Zoölogy at Harvard College. The material upon which this paper is based is from the Museum. The writer is grateful to Professor Nathan Banks for permission to study these specimens.

(RCB + RPPT) inconspicuous, apparently partially fused to H at base and curving around inner base of right cercus. Basal segment of left cercus (LC_1) sclerotized, especially along inner margin, cylindrical with a broadly expanded basal foramen and a slightly swollen apex; a weakly inflated, inner basal lobe bears seven very stout, curved "teeth"; the terminal lobe bears only two such "teeth." Basal segment of right cercus almost entirely membranous; terminal segments of both cerci normal in shape, but submembranous.



Figures 1 to 5, *Metembia flava* n. sp., holotype male: fig. 1, head; fig. 2, terminalia (dorsal); fig. 3, detail of 10 LP; fig. 4, terminalia (ventral); fig. 5, left hind basitarsus.

Explanation of symbols: 9 = 9th tergite; 10 L and 10 R = Left and right hemitergites of tenth segment; 10 LP = left tergal process; 10 RP_1 = major right tergal process; 10 RP_2 = secondary right tergal process; H = hypandrium (9th sternite); HP = hypandrium process; LCB and RCB = left and right cercus-basipodites; RPPT and LPPT = left and right paraprocts; LC_1 = basal segment of left cercus. All drawings are based on Camera Lucida outlines; setæ are omitted; stippling represents membrane; the outline of submentum is dotted.

Female: Unknown.

Holotype: Male, on slide, from Nedungadu, Tanjore, South India, May 2 (P. S. Nathan). Deposited in Museum of Comparative Zoölogy.

Paratype: Male, on slide, with type data but collected February 14. Deposited in the writer's collection.

Flava cannot be confused with the other species of *Metembia*

Davis, i.e., *ferox* Davis (1939a, p. 474) and *immsi* Davis (1939a, p. 475). It may be separated from both by its small size, pale color, short left tergal process (10 LP), and the slight lobes of LC_1 with the few stout "teeth" (echinulations). Both *ferox* and *immsi* have very pronounced basal and apical inner lobes on LC_1 bearing numerous echinulations.

The paratype differs from the holotype only in its more swollen caudal lobe of the composite left paraproct and its possession of three "teeth" on the apical lobe of LC_1 instead of two.

FAMILY OLIGOTOMIDÆ

Oligotoma borneensis Hagen

(Figures 6 to 8)

Oligotoma borneensis Hagen, 1885, Can. Ent., **17**:146 (as "*O. saundersii* Westw.") (Lectotype male: Telang Borneo, M.C.Z.); [1] Krauss, 1911, Zoölogica, **23**:39 (= "*O. saundersii* Westw."); Davis, 1940, Proc. Linn. Soc. N.S.W., **65**:371, figs. 23–37 (establishes identity).[2]

Aposthonia vosseleri Krauss, *Ibid.*, p. 48, pl. II, fig. 14 (Holotype male: Pedang, Sumatra, Stuttgart Mus.); [3] Friederichs, 1934, Arch. Naturg., N.F., 3:409, 410 (*v. vosseleri*), 427 (♀); [4] Davis, *Ibid.*, p. 373 (= *borneënsis* Hagen).

Oligotoma vosseleri (Krauss). Enderlein, 1912, Coll. zool. Selys. Longch., 3:101, fig. 65; Silvestri, 1912, Tijd. voor Ent., 55:334, fig. 6 (Java).

Aposthonia vosseleri intermedia Friederichs, *Ibid.*, p. 410 (as a form) (Kuala-Lumpur); [5] Davis, *Ibid.*, p. 374 (= *borneënsis* Hagen).

Aposthonia vosseleri obscura Friederichs, *Ibid.*, p. 412; Davis, *Ibid.*, p. 375 (= *borneënsis* Hagen).

Oligotoma jacobsoni Silvestri, 1912, Tijd. voor Ent., 55:334 (Holotype male: Semarang, Java; Silvestri Coll.); [6] Davis, *Ibid.*, p. 373 (= *borneënsis* Hagen).

Aposthonia vosseleri jacobsoni (Silvestri). Friederichs, *Ibid.*, p. 411.[7]

Oligotoma mærens Roepke, 1919, Treubia, 1:5, figs. (Merbabu, Java); [8] Davis, *Ibid.*, p. 374 (= *borneënsis* Hagen).

Oligotoma nana Roepke, *Ibid.*, p. 20, figs. (Merbabu, Java); Davis, *Ibid.*, p. 374 (= *borneënsis* Hagen).

Aposthonia vosseleri nana (Roepke). Friederichs, *Ibid.*, p. 412.[9]

Oligotoma masi Navás, 1923, Mem. Pont. Accad. Romana Nuovi Lincei, (2) 6:39 (Holotype male: Vigan, Luzon, P. I., Paris Mus.); [10] Navás, 1932, *Ibid.*, 16:923 (Tonkin record); Davis, *Ibid.*; p. 374, fig. 32 (= *borneënsis*, Hagen, *vide.*, reference to *masi* type).

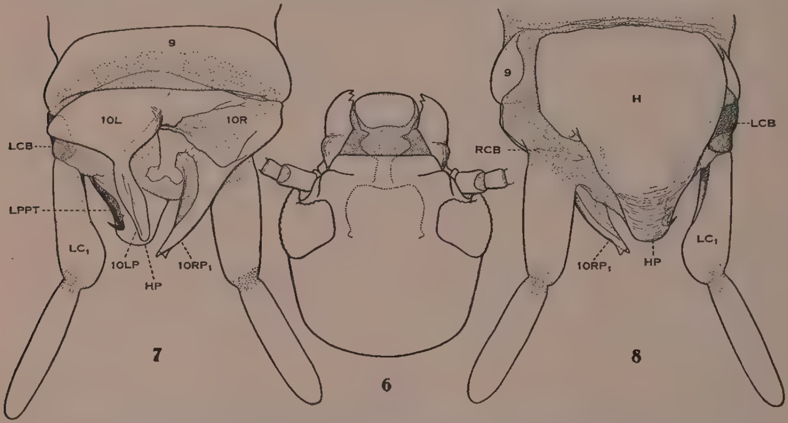
Davis (1940) has regarded as valid the name *borneënsis* which was first used by Hagen (1885, p. 146) but neglected by most later students of the order. Hagen had before him eight specimens of *Oligotoma* from Borneo which, from the wording of his discussion, he had at one time intended to name as a new species "*O. borneensis*," but at the time of writing decided it more prudent to assign to "*saundersii* Westwood." His description intended to apply to the name "*saundersii*" was apparently based solely on these Borneo specimens. It is now clear that this material did indeed represent a new species and not "*saundersii.*" Since Hagen's *borneënsis* was a new name associated with a description it appears that it must be recognized as valid.

Hagen's eight Borneo specimens are today well preserved in the Museum of Comparative Zoölogy, Harvard University. Four of these, in alcohol, from "Telang Borneo, 12.81," labelled in Hagen's hand, "*Olig. Borneense* Hag.," may be regarded as the cotype series. Davis redescribed and figured two uncleared specimens from this series but failed to designate a lectotype. Through the kindness of Dr. Nathan Banks the writer has been permitted to clear and mount two of the cotypes on slides and to designate one as the lectotype. The following brief description and the accompanying figures are based on this specimen.

Lectotype male (on slide): *Color* — head pale golden-brown; basal antennal segment chocolate-brown, flagellar segments light brown at base becoming tan distad; mandibles dark mahogany-brown throughout; submentum dark golden-brown. Pterothorax, legs and wings tan; prothorax and abdomen (except terminalia) paler tan; terminalia varying shades of brown. *Dimensions* — length 10.5 mm., fore-wing length 6 mm., breadth 1.6 mm.

Head and *terminalia* as figured (figs. 6 to 8).

Salient features: Mandibles deeply excised just behind acute medial tooth; basal half massive, with a very pronounced, hirsute, dorsal elevation along outer margin which abruptly arises just within basal half and continues to the articulation point. *Terminalia* with left tergal process (10 LP) elongate, slender, narrowly rounded distad; right process (10 RP$_1$) with a small but distinct, subterminal outer point; hypandrium process (HP) simple, rounded; left paraproct (LPPT) narrow, sclerotic, hooked outward and upward terminally and acutely pointed; left cercus-basipodite (LCB) represented only by a nearly black plate at outer base of left cercus; left cercus with basal segment (LC$_1$) dilated distad.



Figures 6 to 8, *Oligotoma borneënsis* Hagen, Lectotype male: fig. 6, head; fig. 7, terminalia (dorsal); fig. 8, terminalia (ventral). Explanation of symbols under figs. 1 to 5.

Lectotype: male, on slide, from "Telang, Borneo, 12.81," Hagen Collection, deposited in the Museum of Comparative Zoölogy.

Cotypes: three males, one on slide, two in alcohol, same data and disposition.

Additional specimens examined: 1 male, Nan, Siam, I–28 (Alice Mackie) (U.S.N.M.); 1 male, Pattam, Tonkin, IV–12–29, at light (R. E. Wheeler) (M.C.Z.); 3 males, Dwa Bi, and 2 males Ta Han, Hainan, VI–25, VII–5, 20, 25–35 (L. Gressitt) (M.C.Z.).

Recorded distribution[2] (based on males): BORNEO — Telang,[1] Lambang Hiang,[1] Duson Timor;[1] JAVA — Buitenzorg,[2,4,5] Malang,[5,7] Gehassen,[9] Semarang,[6] Merbabu;[8] SUMA-

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[2] Exponential numbers refer to bibliographic citations on page 104.

TRA — Fort de Kock,[4,7] Padang[3] (? Simalur,[4]) Lasikin,[4] Laut Tawar,[4] Sibigo;[4] CEYLON[3] (misidentification?); KUALA LUMPUR;[5] TONKIN — Pattam;[2] HAINAN — Dwa Bi,[2] Ta Han;[2] CHINA — Canton.[5]

The synonymy treated above follows Davis (1940); the writer feels, however, that some portions require confirmation by examination of types. *Oligotoma mœrens* Roepke, for example, may prove to be related to *ceylonica* Enderlein (cf. shape of head, mandibles, and 10 LP) as a representative or relative of that species has been seen by the writer from Sumatra (Langkat, M.C.Z. Coll.). Particular attention should be given to mandibular structure for recognition of *borneënsis* as the terminalia characters of this series of species may be very similar.

Borneënsis is a well-defined, wide-spread species in South East Asia and the East Indies (perhaps extended to this range by human transport). It is a member of the large group of species which have the left cercus-basipodite incomplete or obsolete, as opposed to the *saundersii* group (*vide infra*) in which this structure is a complete ring with a prominent inner lobe. Within this group it may be placed with those species which have the left paraproct (LPPT) sclerotized and caudally terminated as a small, sharp point which is turned outward, i.e., *varians* Navás (1923) from Kwantung, China, *scottiana* Enderlein (1910) from the Seychelles, and *thoracica* Davis (1940) from Burma. There may be additional species which have this combination of characters, if so it is not evident from available descriptions. *Albertisi* Navás (1930) from New Guinea is probably also a relative but the left paraproct is not produced as a sharp point. A brief key to these species follows:

1. Left tergal process (10 LP) tapered, narrowly rounded, or slightly hooked outward distally 2
   Left tergal process slightly expanded and obliquely truncate distad. Burma . . . . *thoracica* Davis
2. Left tergal process narrow, elongate, narrowly rounded at tip 3
   Left tergal process rather broad, obtusely angulate on inner margin, tip abruptly curved outward at apex (mandibles without dorsal elevations). China. . . . . . . *varians* Navás
3. Process of hypandrium (HP) with a subobtuse projection near right apical angle. Seychelles . . *scottiana* Enderlein

Process of hypandrium evenly rounded, without such a projection. S. E. Asia and East Indies . . *borneënsis* Hagen

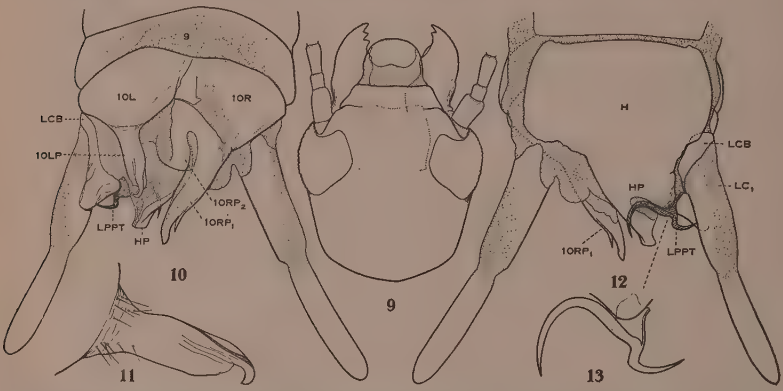
Oligotoma falcis Ross, new species

(Figures 9 to 13)

Holotype male (on slide) *Color* — Head and submentum blackish-brown, mandibles tan with brown inner margins and apices; remainder of body and appendages medium brown except terminalia which is dark brown. *Dimensions* — length 8.5 mm.; fore-wing length 5.2 mm., breadth 1.3 mm.

Head (fig. 9) with form illustrated.

Wings as throughout the genus; with three $C - R_1$ and four $R_1 - R_{2+3}$ cross-veins in fore-wing; five $C - R_1$ and six $R_1 - R_{2+3}$ cross-veins in hind-wing. Hyaline stripes narrow, sharply defined.



Figures 9 to 13, *Oligotoma falcis* n. sp., holotype male: fig. 9, head; fig. 10, terminalia (dorsal); fig. 11, detail of 10 LP; fig. 12, terminalia (ventral); fig. 13, detail of LPPT (ventral). Explanation of symbols under figs. 1 to 5.

Terminalia (figs. 10 to 13) with left tergal process (10 LP) (fig. 11) rather broad, sides subparallel, abruptly, irregularly convergent distad, especially on left side, terminating as a hook directed to the left. Major right tergal process (10 RP_1) narrow, sclerotic apically, narrowly truncate; with a prominent, subapical, outer spine which is somewhat appressed. Left paraproct (LPPT) (fig. 13) developed as a complex, sclerotic, horizontal spine; inner portion narrow, sickle-shaped, crossing venter of HP; outer portion shorter, abruptly turned (90°)

caudad, thence abruptly turned (90°) laterad, tapered distally. Left cercus-basipodite (LCB) membranous laterad but very strongly pigmented and swollen mesad; the inner margin straight, broadly rounded at each end and at least half as long as basal segment of left cercus (LC_1).

Holotype: Male, on slide, from R. Tunga, at light, 1865 feet elevation, Shimoga, Mysore, South India (P. S. Nathan). Deposited in the Museum of Comparative Zoölogy.

Paratypes: Five topotypic males collected in May and July deposited in the above collection and that of the writer.

One additional male at hand, from Nedungadu, South India, IV–6–(P. S. Nathan), is tentatively assigned to this species. However, if a study of a series reveals that its peculiarities are constant in a definite geographic area, it may be regarded as a subspecies of *falcis*. This male differs from the above series as follows: Much larger in size, head light brown, submentum golden in color, eyes more strongly inflated sides of head more strongly convergent (the head of the type series varies in form in this direction, but the color is constant); spine of LPPT stouter (this spine though constantly narrow in the series, varies considerably in size and curvature, especially the arm directed laterad).

Falcis is a close relative of *saundersii* (Westwood) which has been collected at the same locality, but is very distinct from it in many details, e.g., 10 LP is parallel-sided (sides not curved), 10 RP_1 has the subapical tooth more prominent; LCB is more broadly lobed mesad; the spine of LPPT is much narrower, with its lateral extension greatly developed.

Both species are members of a very natural group of *Oligotoma*, centered in distribution in the Indian Region (aside from the spread of three species by man, i.e., *saundersii*, *nigra*, *humbertiana*), which is characterized by the prominent, ring-like left cercus-basipodite with its mesal lobe, and a sclerotic, spine-like development of the left paraproct. These species may be separated as follows:

KEY TO SPECIES OF *Saundersii* GROUP OF *Oligotoma* (MALES)

1. 10 RP_1 with a prominent subapical spine on outer side 2
   10 RP_1 without a subapical spine, or when present it is very small and inconspicuous 3
2. LCB with inner lobe prolonged caudad along inner side of

left cercus as a narrow process; LPPT without a sickle-shaped spine crossing beneath HP .... *humbertiana* (Saussure)

LCB with a simple, broad inner lobe, without a caudal process; LPPT with a sclerotic, sickle-shaped spine crossing beneath HP .... *falcis* Ross

3. LPPT with a broad sickle-shaped spine extending mesad beneath HP; 10 LP broad, spatulate, simple with curved sides .... *saundersii* (Westwood)

LPPT not as above; 10 LP narrow, acuminate or sinuous with apex complex 4

4. 10 LP narrow, gradually tapered distad, simple; .... *nigra* (Hagen)

10 LP broad in basal half, abruptly tapered distad, apex complex .... *greeniana* Enderlein

There is a possibility that *falcis* is identical to *Embia bramina* Saussure described from Bombay (1896, p. 352) the type of which was incompletely figured by Krauss (1911 pl. I, figs. 6, 6A). Davis (1939, p. 184) regarded this species as a synonym of *saundersii* but noted that this view should be confirmed by an examination of Saussure's poorly known holotype in the Geneva Museum. For the present it seems more advisable to apply a new name to these specimens than to refer them to such a doubtful and poorly described species as *bramina*.

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A NEW BEE OF THE GENUS HERIADES FROM PANAMA (HYMENOPTERA, MEGACHILIDÆ)

By Charles D. Michener

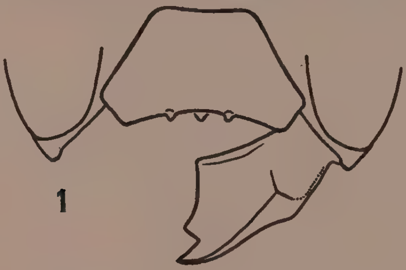
American Museum of Natural History, New York City

The bees of the genus *Heriades* are primarily confined to North America, Eurasia, and Africa. In the western hemisphere the most southern known species has been *Heriades bruneri* Titus from Costa Rica. It is therefore of interest to find in the collection of the American Museum of Natural History a distinct new Panamanian species of this genus.

Heriades (Neotrypetes) currani new species

Female: Length 5½ mm. Pubescence white. Labrum with one basal tubercle; mandible with two longitudinal carinæ, lower one extending from apex nearly to base and somewhat elevated about three-fifths of distance from apex to base, upper extending about half way from apex to base and terminating basally in a low transverse elevation, distance between first and second mandibular teeth about one-half distance between second and third; malar area below and behind produced to an angle; clypeus with apical margin subtruncate, with a pair of small premarginal tubercles separated from one another by less than basal width of clypeus; surface of clypeus evenly convex, punctation of apical portion fine and dense, of basal portion as coarse as that of supraclypeal area; punctation of vertex and mesepisterna slightly finer than that of mesoscutum and mesoscutellum; base of propodeum with the usual transverse row of very large depressions; wings slightly dusky; abdominal terga middorsally with punctures separated by slightly less than their diameters, somewhat coarser on posterior than on anterior segments, terga one to five with apical fasciæ of white pubescence.

Male: Length 5 mm. Similar to female. Shortest distance between eyes slightly more than half length of eye; first flagellar segment nearly twice as broad as long; outer margin of mandible straight basally seen from front; labrum with basal raised area; abdominal terga more closely punctured than in female, abruptly more coarsely punctured on third and following terga than on first two, punctures contiguous on posterior terga; profile of sixth tergum slightly elevated apically; first abdominal sternum with posterior margin rounded, in profile with gentle convexity about two-thirds of its length from base to apex; fifth sternum with an acutely pointed median process laterad of which lie the usual rows of long capitate hairs; sixth sternum but little down-curved at apex, subapical hairs rather numerous and long, extending beyond margin of sternum.



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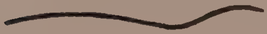

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Fig. 1, Lower part of face of female *Heriades currani*, one mandible omitted; Fig. 2, Profile of first abdominal sternum of male *Heriades currani*, base at left.

Holotype female, Panama, Republic of Panama, February to March, 1915; allotype male, Patilla Point, Canal Zone, Panama, January 15, 1929, collected by Dr. C. H. Curran after whom this species is named. Both specimens are in the collection of The American Museum of Natural History.

In the revision of American *Heriades* (Michener, 1938, Ann. Ent. Soc. Am., 31: 514–531) this species runs clearly to the subgenus *Neotrypetes*. In the key to the species of that subgenus the male runs best to *leavitti* Crawford, a form differing from *currani* by the dark wings, longer first flagellar segment, etc. The female as well as the male seems most closely related to *H. crucifera* Cockerell from New Mexico and Arizona, although because of the proximity of the premarginal tubercles of the clypeus it will not run to that species in the key. It differs further from *crucifera* by the less strongly angular malar area, the somewhat differently arranged carinæ near the bases of the mandibles, etc. From *H. bruneri* Titus, the species geographically closest to *currani*, the latter differs by its coarsely punctate abdomen and white rather than yellow pubescence. Like *H. texana* Michener, and unlike other species, *currani* has an elevation on the ventral mandibular carina of the female, but it is not nearly so conspicuous as in *texana*.

A NOXIOUS SPECIES OF PHLEBOTOMUS IN THE OKEFENOKEE SWAMP, GEORGIA

By O. A. Johannsen

Cornell University, Ithaca, N. Y.

A group of biologists from Cornell University, on a collecting expedition, visited the Okefenokee Swamp in southern Georgia in the summer of 1912, establishing headquarters on Billy's Island. On July first a trip was made to Minnie's Island in one of the remoter parts of the swamp. Here during the night the members of the party were tormented by tiny gnats which the natives called "Merry Wings" because they were "all wings and no body." The following morning one member of the party counted over 75 punctures on his body, another's hands and arms were swollen to abnormal size, the swelling not subsiding for a day or more, and a third seemed to develop a slight fever. No specimens were obtained that night, but after the party had returned to Ithaca some were sent to the department of entomology, by a Mr. Lee, a native of the swamp. The flies, which proved to be a species of *Phlebotomus*, bore the label "Merye winges," a retention of Elizabethan spelling that is quite in accord with the prevailing language of the region. The Lees are such keen observers of natural phenomena and were found so dependable in their statements that there can be no question as to the specimens sent being the same species that proved so troublesome to the party on Minnie's Island. One of the Lees who acted as guide was so hesitant about going to the island that he was suspected of some ulterior motive until he confessed that he dreaded the "merry wings." I am indebted to three members of the expedition, Professors J. C. Bradley, W. D. Funkhouser, and A. H. Wright, for the foregoing statements.

Only two or three defective female specimens in alcohol were sent to us, and of these only one is now available for study, and this lacks vestiture, legs, and part of the antennæ. When first received it was determined as *Phlebotomus vexator* Coq., agreeing in all characters given in the description. Since then I have had an opportunity to compare it with a female specimen of *P. vexator* from Plummer's Island, Maryland, the type locality, and find that the two differ distinctly in wing venation and palpal proportions. I have been informed by Dr. J. Bequært of Harvard University that Dr. Marshall Hertig, who kept and bred P. *vexator* in captivity for several years was not able to make it bite man, although it fed readily on reptiles. At Dr. Bequært's suggestion this note is published, calling attention to the Georgia species which is certainly noxious to man, and with the hope that some entomologist may find opportunity to collect and describe it.

THE APPEARANCE OF *VESPULA SQUAMOSA* DRURY IN MISSOURI

By Phil Rau, Kirkwood, Missouri

Carl D. Duncan[1] regards as *Vespula maculifrons* Buyss. the yellow jacket about which I have published two papers as *Vespa germanica*.[2] Recently Miss Grace A. Sandhouse likewise named specimens submitted to her for examination as *Vespula maculifrons*.

In the spring I have always liked to watch the queens hunting for nesting sites, and for many years the clay bank in my garden, with its many crevices and old wasp and bee burrows, was a favorite hunting area. During the past three years, however, I occasionally saw searching about the clay bank a Vespula queen that differed somewhat in color from what I was accustomed to seeing. Upon submitting a specimen to Miss Sandhouse for identification, I learned that the species is *Vespula squamosa* Drury (= *V. carolina*). This I think is the first record for this wasp in Missouri.

Lewis, in his paper on "Vespinæ of the U. S. and Canada" (Trans. Amer. Ent. Soc. 24:180–181, 1897) gives its habitat under the name *V. carolina* as Pennsylvania, and under the name *V. squamosa* as New York. Turner, in his paper "The Workers of *V. carolina* resemble in Coloration the Males" (Psyche 15:1–3, 1908), records digging up a large nest at Atlanta, Georgia.

How generally *V. squamosa* is established in Missouri is not known, but at Kirkwood I am sure I have seen the queens for at least three years.

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[1] A Contribution to the Biology of N. A. Vespine Wasps, Stanford Univ. Press, 1939.

[2] "Behavior Notes on the Yellow Jacket, *V. germanica*" Ent. News, 41:185–190, 1930, and "An Unusual Nest of the Yellow Jacket, *V. germanica*," Bull. Brooklyn Ent. Soc. **26**:85–89, 1931.

SUPPLEMENTARY NOTES ON CALISTO (LEPIDOPTERA: SATYRIDÆ)[1]

By Harry K. Clench

Cambridge, Mass.

In a recent number of Psyche I published a paper on *Calisto*[2] in which five new forms (one species and four subspecies) were described. While this paper was in press, too far advanced to be recalled, I received a copy of Dr. C. D. Michener's paper on the same genus.[3] Thus, by an unfortunate coincidence (neither of us was aware of the other's work), a slight confusion has arisen. This confusion is not so serious as it might have been, and is easily corrected. Below are given the forms described by me that are likely to be confused.

Calisto batesi Clench (*op. cit.*, p. 23) is a homonym of *Calisto hysius batesi* Michener (*op. cit.*, p. 3). In place of this name, which is thus no longer valid, I propose **Calisto micheneri**, new name.

Calisto hysius montana Clench (*op. cit.*, p. 24) is unaffected and still stands, being something other than Dr. Michener's subspecies.

Calisto confusa debarriera Clench (*op. cit.*, p. 25) is correctly placed by me under *confusa*, of which it is possibly only an altitudinal modification. Michener (*op. cit.*, p. 5) erred in referring Bates' "Variety B" (1935, Occ. Papers Boston Soc. Nat. Hist. 8, p. 240(239)) to *obscura* Michener, "Variety B" is still to be placed in the synonymy of *debarriera*.

Calisto obscura Michener is an exceedingly interesting discovery, which I must confess I completely overlooked when preparing my paper, although the species is well represented in the collection of the Museum of Comparative Zoölogy. Localities for *obscura* in the M. C. Z. collection (other than those given by Michener) are as follows: Puerto Sosua (Rep. Dom.); Mt. Rouis; Dessalines; Ennery (all Haiti).

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[1] Published with the aid of a grant from the Museum of Comparative Zoölogy at Harvard College.

[2] Some New Callisto from Hispaniola and Cuba. Psyche 50, pp. 23–29, March–June 1943. (Issued August, 1943.)

[3] A Review of the genus Calisto, Am. Mus. Novit. No. 1236, June 22, 1943.

BOOK REVIEW

The Carnivorous Plants, by Francis E. Lloyd. xv + 352 pp., 39 plates. Waltham, Massachusetts, The Chronica Botanica Co.; New York, G. E. Stechert & Co. $6.00.

Although this is primarily a botanical treatise, it deals with a series of peculiarly modified plants that are of great interest to zoölogists and especially to entomologists. Most generally known as insectivorous plants, they have long excited much speculation in the minds of many observers and aroused the interest of numerous professional biologists. Most noteworthy of the previous accounts is, of course, Charles Darwin's "Insectivorous Plants" published in 1875. This treatment reveals the great selectionist as an experimental biologist, a rôle usually overlooked and overshadowed by his contributions in other fields.

Lloyd's book gives a very complete account of all of this literature from the earliest accounts by travelers, botanists and many others before Darwin, as well as the subsequent period during which numerous students have added much information, notably the German botanist Goebel. Formerly a student of Goebel, Lloyd himself has contributed a number of papers, particularly on Utricularia. The historical account includes many controversial matters relating to the anatomy and physiology of the plants, some of which have not even yet been fully clarified. The text is restricted to plants which actually catch or trap living animals (usually insects) and omits the numerous parasitic fungi and bacteria on the basis that they are not carnivorous in the sense of being really predatory. The several plants are dealt with in the order of increasing complexity in the structure of trapping devices, each genus or type forming a separate chapter.

Of the flowering plants, members of six families, numbering 450 species in fifteen genera are referred to. Their distribution is remarkable, two genera are nearly cosmopolitan (Drosera, Utricularia); several are very widespread (Aldrovandra, Nepenthes, Pinguicula), while at least seven are confined to restricted or very small areas, culminating in Dionæa whose range is included in a stretch of hardly 100 miles in the coastal lowlands of North Carolina. Three families and six genera are native to the United States, including the pitcher plants (Sarracenia and Darlingtonia) of the Sarraceniaceæ, the sundew (Drosera) and Venus' fly-trap (Dionæa) of the Droseraceæ, butterwort (Pinguicula) and bladderwort (Utricularia) of the Lentibulariaceæ.

The traps are classified by Lloyd as "pitfalls" represented by the tubular leaves of the pitcher plants; as "lobster pots" in Genlisea; as "bird-lime" or "fly-paper" traps in Drosera, Pinguicula, *et al.*; as "steel trap" in Dionæa and finally as "mouse-trap" in Utricularia. The last is described at great length since Lloyd has found their underwater contraption to be more complicated and still more remarkable than had previously been supposed.

Particularly instructive is a chapter devoted to fungi that catch Protozoa, nematodes, and minute crustaceans by means of snares and feed on them by mycelial outgrowths that pierce their bodies. There is a full discussion of the mechanism involved in the movements shown by the several types of active traps and a critical examination of the mass of evidence relating to digestive secretions, actual digestion of captured prey and utilization of nitrogen. The presence of digestive enzymes has been demonstrated generally in the true carnivorous plants, but their elaboration by the plants themselves rather than by secondarily invading microörganisms is considered in great detail. In many cases no final conclusions have been reached, leaving a number of interesting and not too difficult problems still open to investigation.

The book is very attractively printed, with an extensive, well classified biobliography attached to each chapter, and a good index. The illustrations are grouped into 38 plates, with a great many well executed line figures of anatomical details. There are a few photographs of the plants, but unfortunately they do not possess the same degree of excellence, excepting some very fine frames of motion pictures showing the action of the trap in Utricularia.

Although very clearly written, the text appears somewhat tedious in many places by the meticulous description of anatomical details and a recitation of the statements of many observers whose conclusions have since been controverted and disproven. This failure to emphasize the present status of knowledge renders the text at times difficult to use as a reference book.

Entomologists will find the book indispensable in answering all sorts of questions that arise concerning these remarkable plants and in suggesting fruitful problems that await investigation.

Charles T. Brues

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